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### HISTORY OF CANADIAN SURGERY

INGERSOLL OLMSTED (1864 - 1937)

A. I. OLMSTED, M.D., Hamilton, Ont.

In April 1935, Dr. Olmsted was persuaded to address the Hamilton Association for the Advancement of Literature, Science and Art. He rather reluctantly consented to give this address as he did not particularly enjoy speaking to lay audiences, but felt that there was much that could be told of the progress of medicine, surgery and improvement in hospital services in the community that was not known or appreciated by the general public. His paper was entitled "Reminiscences", and in the course of its delivery many facets of the speaker's own individuality were revealed. Much of the subject matter in this article is garnered from this source.

Ingersoll Olmsted was born in the village of Ancaster, Ontario, in the year 1864 and after the usual pre-medical training entered the medical school of the University of Toronto, graduating in the year 1886. He was appointed assistant physician to the Hamilton City Hospital in December 1886, and after six weeks' training he became resident when the incumbent resigned. At this time he noted that there was an average of 70 to 90 patients in the hospital; not many operations were performed and what surgery was done was mostly for tumours, with an occasional acute gall-bladder or drainage of an appendiceal abscess.

It was at this time that he came to know Dr. Archibald Malloch, who was to influence so much his future career. Malloch at this time was the foremost surgeon in the community, and had been house surgeon to Sir Joseph Lister at the time he was developing his antiseptic technique.

On one occason, in Lister's absence, a visitor was brought to the clinic by Sir George B. McLeod of Glasgow. The stranger was Dr. Samuel A. Gross of Philadelphia, then a leading surgeon of the United States. In Lister's absence, Malloch was in charge. Sir George introduced Gross



Fig. 1.-Dr. Ingersoll Olmsted.

and requested that he be allowed to see some cases treated by the new method. Malloch then proceeded to show a case of compound fracture of the leg in a man who had been dragged along the road and had suffered a burning of the skin by friction, which had caused considerable reddening of the area. Malloch read the history of the case before exposing the leg. When the dressing had been removed, Gross turned to Sir George and drew his attention to the reddened area of skin and remarked: "You see, Sir George, that this burning is due to the carbolic acid solution". Malloch said, "Excuse me, Dr. Gross, the history I read you stated that the burning was present on admission". "Do not talk that way to me, young man, I know what caused it", was the reply. Malloch bound up the leg and turning to Sir George said, "No more cases

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will be shown to this man. He doubts my word", and persuasion to alter his decision was unavailing. He was later supported by his chief in his position. By the time Olmsted became associated with Malloch, he was even more definite in his opinions. Subsequently in 1868, Malloch settled in Hamilton and introduced the Lister technique to this area, before it became generally recognized in this country following papers by Dr. (later Sir Thomas) Roddick, in 1873.

In 1887, the next step was an internship in the German Hospital in Philadelphia, where a much larger volume of work was encountered, but the impression gained was that the type of surgery being done suffered by comparison with that performed by his mentor, Malloch. During this period opportunity was offered to learn German, and in addition to his daily duties, lessons in this language were added to the schedule, so that when Olmsted completed his internship, he was able to read and speak German. It was at this time that Olmsted first met William Osler, then professor of clinical medicine at the University of Pennsylvania, and was impressed by the amount of teaching and research that Osler managed to accomplish. At that time Osler was particularly interested in the study of blood in malaria. Whenever a patient with malaria had a chill, the house physician was instructed to bring a blood sample at any hour of the day or night to Osler's home, where microscopic examination was done immediately. In 1889, Osler moved on to take the professorship of medicine at the newly opened Johns Hopkins Hospital in Baltimore, along with Welch in pathology, Halsted in surgery, and Kelly in gynæcology.

Following his period of internship in Philadelphia, Olmsted hung out his shingle and found more spare time than he had been accustomed to. However he noted that this gave him the opportunity for reading and for the autopsies which he was allowed to do at the City Hospital. About this time (1890) there was trouble at the hospital. The resident had resigned without warning, so the committee in charge asked Olmsted to come and try to get things straightened out. The situation when he arrived was

critical. There were very few nurses, all of whom were very young and only one had been there more than six weeks. At this time there were 96 patients in the hospital, with no trained help. Two nurses who had left at the same time as the resident physician were personally visited by Olmsted and persuaded to return to duty. Two medical undergraduates were found and given quarters to help out, and gradually after "work that never seemed to end" the situation was straightened out. It was at this time that the training school for nurses was started. Olmsted's mother designed a pin which is still in use, and shortly after this the first class of two nurses was graduated. This was only the second or third school of nursing in Canada at the time.

In 1893, Olmsted was offered the position of assistant in bacteriology at the University of Pennsylvania, and returned to Philadelphia. As most of the literature on the subject at this time was in French or German, much spadework was needed in brushing up on these languages. At this period he contracted an infection in his foot, with the result that he returned to Hamilton and the care of his great friend, Malloch. In spite of every measure taken, spread of the infection necessitated a below-knee amputation. After his recovery from this operation, Olmsted resigned from the university and went to Europe, where he spent the best part of two years.

When he arrived in Heidelberg, he went to the Krankenhaus and presented his card to Erb, at that time one of the best teachers of internal medicine in Europe. He was fortunate enough to meet him just as he was making his rounds. The professor was a very active man and used to climb stairs two or three steps at a time. Olmsted said that his wooden leg worked well and that he was able to get up stairs as fast as Erb, but coming down was a different matter. When Erb noticed him limping down, he waited and when level ground was reached Olmsted walked almost naturally with very little limp. He said, "Herr Geheimrat, what is the diagnosis?" The latter replied, "What is the matter?", and was told. Apparently the artificial legs made in Germany at that time could not compare with those made n America, and a man with an artificial

leg could be spotted a mile off!
Olmsted was much impres

Olmsted was much impressed by the teaching at the university, particularly by that of Erb in internal medicine and of Arnold in pathology, but what he was mable to understand was that in the medical wards, where heart, lung and nervous patients were being cared for, a case of diphtheria was also being nursed. He stated that ten years before in Hamilton such cases had been separated, whereas in Berlin in 1895, patients with scarlet fever, measles, and diphtheria were all housed in the same ward!

Following his European tour, Olmsted returned to Hamilton, where he again entered active practice, introducing new procedures that he had learned overseas. He still lacked private patients but his friend Dr. English was at that time superintendent of the local mental hospital, and in this institution he found a wealth of material to keep him busy. One patient was the possessor of a large tumour on his back which gave him the appearance of a hunchback. When the tumour was successfully removed, the patient escaped from the hospital and his appearance was so much altered that he was never found.

Another branch of surgery which was opened up to Olmsted was that of the thyroid gland. He had had the opportunity to observe the Swiss surgeons who were pioneering in this field and on his return home he began operating on the goitres which were then so common in this area. He took a great deal of pleasure, when he had a visiting surgeon staying with him, in taking his guest on a tour of the local market where large goitres were almost as prevalent as the fruit of the district.

In 1902, Olmsted married Miss Edith Wood and moved to larger quarters. At about this time he installed an x-ray machine, the first in the community. He then proceeded to experiment with this new art of radiography. Since the "films" of this period were an emulsion on a slab of glass, it was not long before storage space became a real problem.

In 1889, Johns Hopkins Hospital started with four chiefs, Welch, Halsted, Osler and Kelly. It was a mecca for medical men. There were no undergraduate students. At about this time, Lafleur, the two brothers McRae, Barker, Futcher, Cullen and the two McCallums were all Canadians connected with the hospital, and all went on to distinguished careers. Through his former acquaintance with Osler, Olmsted met the other chiefs, who were extremely kind to him. He made a particular friend of Howard A. Kelly who had married a German girl who spoke only a little English. She made Olmsted very welcome, as she loved to chat in her native language. Kelly had a summer home on the Magnetawan and used to visit Hamilton on the way to or from the cottage.

Kelly was also responsible for bringing to America a young German illustrator named Max Brödel, who was responsible for the beautiful illustrations in Kelly's books. He later started the first school of medical art in the country. Many of us are familiar with his beautiful drawings, which illustrated so many articles and textbooks during this time.

As well as Johns Hopkins, Olmsted enjoyed visiting the Mayo Clinic, where he had many friends, particularly Donald Balfour, whom he had known in Hamilton, and who always made him welcome and demonstrated anything new in the field of surgery that had come out of that great institution.

As time went by, his volume of work increased but he always managed time for his fishing and duck shooting which he enjoyed to the full, and many a ward nurse learned to cook brook trout for some particular patient under the doctor's eagle eve. He had also become interested in golf and not only enjoyed the game itself but, as chairman of the greens committee over a long period, became quite an expert on the turf and landscaping and thus improved the course immensely over a period of years. Once a year a team from a Toronto club arrived for a friendly match. One of the visiting club members had the same leg disability as Olmsted, so naturally they were matched together and as their games were about equal, many an epic struggle went on between the two.

During the earlier years of his practice, much of the emergency surgery was of necessity performed on the kitchen tables in the surrounding communities. As roads and methods of transportation later improved, more and more of this type of work was brought into the local hospitals. It was at this period that Olmsted got his greatest pleasure out of teaching. Although there was no university in connection with the Hamilton hospitals, the doctor always managed to have a group, large or small, when he made his rounds and usually the listeners were well rewarded. He always stated that the proper use of the powers of observation was one of the most important diagnostic aids. When he was fortunate enough to discover a patient with a glass eve on the wards, all available nurses and interns were immediately gathered up for a diagnostic clinic with pungent remarks on the subject of observation.

Olmsted was a great believer in the use of gas anæsthesia when this type of medium was introduced and performed many of his so-called minor operations under this medium when Donald Warren and the late William Cody became proficient in its use. A medical confrère presented himself one day with a nasty infected finger and the suggestion was made that he have a "whiff of gas" before incision. The patient replied to this that "I have opened hundreds of these things by freezing them with ethyl chloride". Olmsted said, "I'll tell you what we'll do. You freeze your finger and when it is ready let me know and I'll open it". When he got the word, he laid the finger wide open and for a few minutes the air was blue. The answer to these words was, "Well, doctor, it hurt all your hundreds of patients just as much as it did you".

The doctor liked a winter golfing holiday and used to go down to Bermuda, taking with him Nicol Thompson, a good friend and the professional at the Hamilton Golf and Country Club. On one of his visits he fell and injured his good leg (avulsion of the quadriceps tendon from the patella).

Not long before this happened, the article of Gallie and LeMesurier on the fascial repair of ruptured patellar tendon had appeared. So, after one of his Bermuda friends had applied a cast, he made tracks for Toronto, where Gallie and LeMesurier effected a repair so beautifully that he never had any trouble or complaint for the remainder of his days.

In the early 1920's, a group of younger surgeons were coming into their own and the doctor took the greatest interest in their development. The late Dr. J. K. McGregor in thyroid surgery, Dr. F. B. Mowbray in the newly developed surgery of the chest, Dr. D. U. McGregor in urology, and Dr. E. C. Janes with new techniques in orthopædics, such as leg lengthening operations and hip pinning, were fascinating to Olmsted, who in return poured out his knowledge gained over the years to his younger colleagues.

He also took a great deal of interest in the pathological studies of his surgical patients, with the result that he and Dr. W. J. Deadman, who was at this time pathologist at the local hospital, became the greatest of friends.

Olmsted during his career belonged to a number of medical societies, but he was very much flattered when he was invited to become one of the first Canadian members of the American Surgical Society, a group that he much admired and enjoyed after his election to membership.

With his busy practice, friends, and varied interests, the years passed pleasantly, and until his death in 1937 he kept his enthusiasm and interest in all that went on about him. He left a community which sincerely mourned his passing. The fact that an appreciation, appearing in the Canadian Medical Association Journal, was signed by Archibald Malloch, the son of his great friend and associate, would have given him great comfort and pleasure.

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## OBSERVATIONS ON THROMBOSIS AND ENDOTHELIAL REPAIR FOLLOWING APPLICATION OF EXTERNAL PRESSURE TO A VEIN®

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THE CAUSE OF thrombosis in veins is, in nost instances, quite obscure. Traditionally, hanges in the blood flow, in the composition of the blood and in the vessel wall tself are blamed, but the roles of these actors in the initiation and propagation of a thrombus are almost as ill-defined today is they were in the days of Virchow, who irst enumerated them.

Interest in the behaviour of the vascular vall in response to a variety of stimuli has been renewed by the observations of Chambers and Zweifach, O'Neill, Samuels and Webster, and McGovern, and more recently, by Poole, Sanders and Florey who observed the process of repair of the rabbit's aortic endothelium following direct trauma.

The purpose of the present study was to observe the effects upon the vein wall of pressure applied directly to its external surface and, by varying the amount of pressure and the duration of its application, to form some estimate of the fragility and recuperative powers of the endothelium and of the degree of injury necessary to produce thrombosis.

#### METHOD

Four hundred and fifty adult Wistar rats of both sexes, weighing from 150 to 250 grams, were used. The animals were anæsthetized with intraperitoneal pentobarbital (Nembutal) in the dosage 6 mg./100 grams. Using sterile instruments, the abdomen was opened and the vena

cava exposed by gently displacing the gut. A sterilized pressure foot, approximately 4 mm. in diameter, projecting below the weight pan of a lever (Fig. 1) was then applied to the

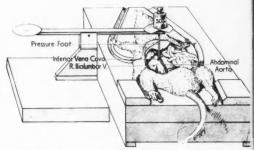


Fig. 1.—Method of applying pressure to the inferio vena cava.

surface of the vein. If the pressure was to be applied for more than a few minutes, the abdomen was closed about the pressure foot to prevent dehydration. Records were kept of the degree of pressure applied, its duration and the site of the pressure in relation to the renal veins or other large branches of the vena cava. If the immediate effect of the pressure was to be observed, the vein was stained and fixed (see below) as soon as the pressure foot was removed. In order to study the progress of events after the injury, groups of animals were anæsthetized with ether and their veins prepared at the following intervals after removal of the pressure and closure of the abdomen: three hours, 24 hours, 48 hours, 60 hours, 72 hours, 84 hours, 96 hours and 144 hours. In the intervals the animals were kept in their cages and offered water and their usual food.

#### Technique of Vein Preparation

The following is a modification of Mann's perfusion technique<sup>6</sup> and similar to that used by Poole, Sanders and Florey.<sup>5</sup> In the anæsthetized animal, a femoral vein was exposed and a 20 gauge needle inserted. Both jugular veins were divided to permit drainage and the perfusion of 5% dextrose in water started immediately (the level in the reservoir being ap-

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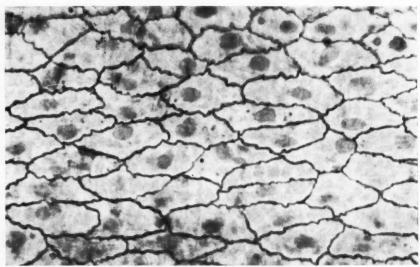


Fig. 2.—Normal endothelium of the rat inferior vena cava, Silver nitrate and Harris's haematoxylin  $(x\ 500)$ .

proximately 40 inches above the animal). When the perfusate came through clear, usually within 30 seconds, 4.0 ml. of 0.4% silver nitrate solution was injected rapidly via the perfusion tubing, the flow of dextrose solution being momentarily checked. Death of the animal usually occurred at this time. The excess silver nitrate was flushed out with a short (30 seconds) perfusion of 5% dextrose in water and this was followed by perfusion with 10% formalin in normal saline for five to 15 minutes.

The thoracic inferior vena cava was opened longitudinally and dissected out, beginning at the right atrium. This dissection was facilitated by continuing the perfusion. The vein was then divided just above the diaphragm and placed on a slide, endothelial surface uppermost. Similar sharp dissection freed the remainder of the vena cava below the liver and this section was placed on a slide in the same manner. The slide was then flooded with Harris's hæmatoxylin. The section was examined until such time as nuclear staining was judged to be satisfactory and then the hæmatoxylin was washed off with 5% dextrose in water. A cover slip was applied and held in place by aluminum foil and the preparation immersed in 10% formalin for 24 hours and then dehydrated by serial passage through graded alcohols. Clearing was obtained by immersion of the slide in xylol for 24 hours and the preparation was then mounted (permount).

The venæ cavæ of 450 rats were examined. Eighty-six served as controls and

these were prepared and examined in groups at intervals throughout the study. The control experiments were designed to assess the effect upon the endothelium of the anæsthetic agents and techniques, of the perfusion and the subsequent dissection and of the operation to expose the vena cava. The thoracic vena cava and the abdominal vena cava above and below the point of pressure also served as controls.

The normal vein wall, as revealed by this technique and seen in control animals and in the experimental animals at a distance from the injured zone, consists of a sheet of endothelium composed of fairly regularly placed pale basophilic rounded nuclei, rarely with nucleoli, surrounded by a clear cytoplasm. The apparent cell boundary is a wavy thin line of argyrophilic substance outlining a roughly diamondshaped area with its long axis in the length of the vein (Fig. 2). Very rarely are two nuclei seen within one boundary. Just beneath this layer lie numerous cells with elongated nuclei with blunted ends with their long axis disposed transversely. The cytoplasm of these cells, which are believed to be muscle cells, is not seen clearly with this technique of staining. Deep to these cells is a zone of whorled fibrous tissue with widely scattered nuclei and

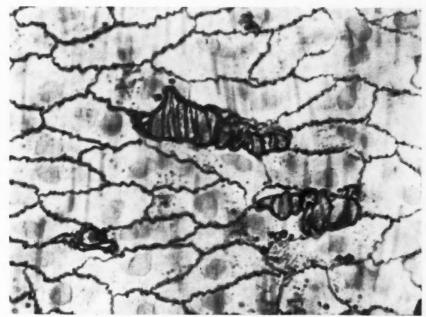


Fig. 3.—Minimal injury to the endothelium produced by the application of 50 grams for 10 seconds. Animal perfused immediately after removal of pressure foot. Silver nitrate and Harris's hæmatoxylin (x 500).

running through this zone are seen numerous capillaries. External to this again is found a layer consisting for the most part of a fatty areolar tissue with numerous larger thin-walled vessels coursing through it. Scattered here and there in the external layers and especially grouped along the capillaries, numerous mast cells are seen.

#### Effects of Pressure

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(a) Low pressure for short duration.— No change was noted in the endothelium of veins upon which a very small weight (5 grams) was applied for a short time (10 seconds). However, a weight of 10 grams applied for 30 seconds or 50 grams applied for 10 seconds regularly produced a localized lesion as shown in Fig. 3. Scattered over the surface in the region to which pressure was applied are seen zones occupying an area of one to four endothelial "cells" bounded by heavy argyrophilic lines corresponding in the main to the boundaries of the surrounding normal cells. Within these zones, closely arranged parallel lines of argyrophilic substance run transversely to the long axis of the vent. Between these lines the nuclei of the subendothelial muscle fibres can be made out (Fig. 4), and here and there the nuclei of the "involved cells" are seen lying in approximately the same plane as the parallel lines. These changes were seen in every instance in which the above pressures were applied (10 rats). That they are reversible is strongly suggested by the fact that in those cases (11 rats) where the examination was carried out five or more hours after removal of the weight, the endothelium appeared normal. The progression of disappearance of the lesion is indicated by the fact that of seven animals examined at 2 hours all still showed the lesion, while of 12 animals examined at 3 hours seven showed the lesion and in five it was not present and presumably had disappeared. There was no evidence of cellular prolifera-

(b) High pressure applied longer.— Weights of 100 grams and 200 grams were applied to the vena cava for one hour and

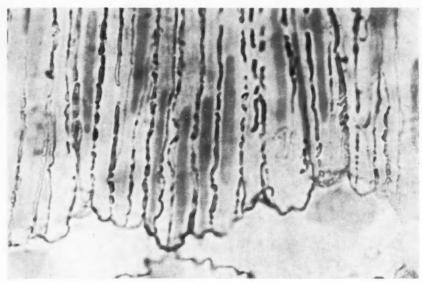


Fig. 4.—Argyrophilic lines parallel to smooth muscle fibres in the zone of injury, Silver nitrate and Harris's hæmatoxylin (x 1700).

for 3 hours respectively. The effects of the two weights were fundamentally the same and consisted of destruction of the endothelial layer with frequent formation of platelet and white blood cell thrombi. Repair took place by means of endothelial cellular ingrowth from the margins of the lesion, and the process of repair as it was observed to occur in a series of 54 rats to whose venæ cavæ 100 grams pressure was applied for one hour is described as follows:



Fig. 5.—Part of the lesion seen immediately following the application of 100 grams for one hour, Silver nitrate and Harris's hæmatoxylin (x 184).

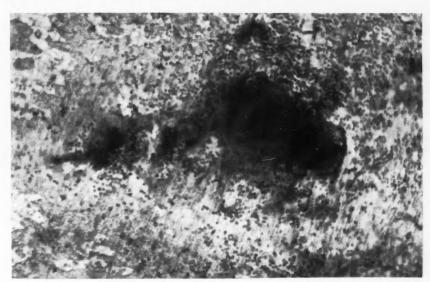


Fig. 6.—Thrombus and leukocytes seen on surface of a lesion three hours after the application of 100 grams for one hour, Silver nitrate and Harris's hæmatoxylin (x 184).

Immediately after the pressure foot was removed, the injured zone, approximately 2 mm. in width and running across the vein, was easily detected by the absence of endothelial cells and their replacement by argyrophilic lines running at right angles to the long axis of the vein (Fig. 5) with

large numbers of platelets lying on the surface. Examination of specimens three hours after removal of the pressure foot revealed masses of leukocytes on the surface and in the deeper layers of the wall. Platelets and platelet thrombi were a common feature (Fig. 6). Fusion in places between the

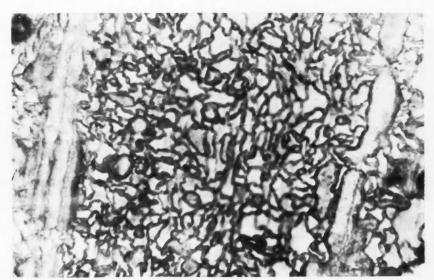


Fig. 7.—Lacy network of argyrophilic material on the surface of a lesion three hours after the application of 100 grams for one hour. Silver nitrate and Harris's hæmatoxylin (x 1800).

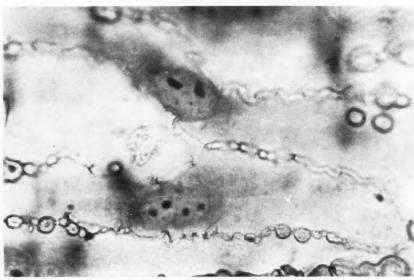


Fig. 8.—Nucleoli in cells adjacent to lesion 24 hours after the application of 100 grams for one hour. Silver nitrate and Harris's hæmatoxylin (x 1700).

argyrophilic lines was now seen, lending the appearance of a lacy network (Fig. 7).

At 24 hours, the first signs of repair were seen in the form of the development of nucleoli in the endothelial cells surrounding the injured zone (Fig. 8). The numbers

of white blood cells on the surface had decreased markedly but the lacy network of argyrophilic substance was still prominent. By 48 hours mitotic figures had appeared in the surrounding cells and actual division could be seen (Figs. 9-11). At the

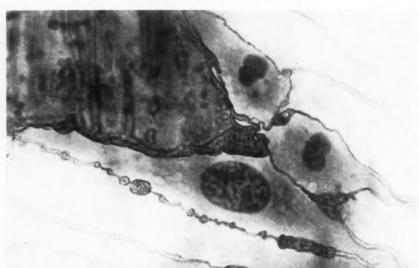


Fig. 9.—Mitosis of endothelial cells at the edge of a lesion 60 hours following application of 100 grams for one hour. Platelets are visible on surface of lesion, Silver nitrate and Harris's hæmatoxylin (x 1700).

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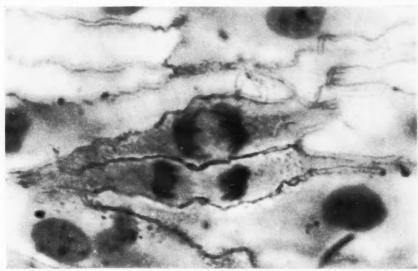


Fig. 10.—Mitoses of endothelial cells adjacent to lesion. Examined 84 hours after application of 100 grams for one hour. Silver nitrate and Harris's hæmatoxylin (x 1700).

same time, on the surface of the lesion fusiform cells were found. Some of these had long filamentous extensions, others were actively dividing (Figs. 12 and 13). In the deeper layers of the wall, the connective tissue cells showed evidence of marked activity in the form of the appearance of young fibroblasts. In some specimens where 200 grams had been applied to the vein for 3 hours, mitoses in the smooth muscle cells were seen at 48 hours.

Between 60 and 96 hours the ingrowth of endothelium from the periphery was completed. The cells were much smaller and more closely packed than normally and they were jumbled (Fig. 14). Mitotic figures were still seen in considerable numbers. Any thrombi seen at this stage were fully endothelialized (Fig. 15). Platelets and white blood cells were no longer found. By 144 hours mitoses had ceased, a few nucleoli were seen, endothelialized thrombi were still present and the cells were still closely packed and jumbled. Deeper in the vessel wall immature cells were no longer seen.

#### External Pressure

Changes in the inferior vena cava similar to those described above were produced in a group of eight animals by applying pressure to the intact abdominal wall by a weight of 600 grams transmitted through a 7 mm. wide bar of wood placed across the abdomen for times varying from 2 minutes to 3 hours (Fig. 16).

#### COMMENTS

Method: It should be emphasized that in the above method every effort was made to avoid injuring the vein in any other way than that due to the experiment. Investigation showed that a light pinch with delicate ophthalmic forceps, even up to three hours after death, produced changes in the endothelium similar to those just de cribed; hence the necessity of full fixation of the specimen prior to its dissection. Artefacts developed from time to time, particularly during the early part of the work (a bubbling appearance of the cement lines, a building up of argyrophilic substances in blob; along the cement lines, etc.) and these may well have been due to technique. They were rarely seen once a standard method was evolved and rigidly followed. It is entirely possible that the stigmata and stomata described by others may be artefacts brought out by a particular technique.

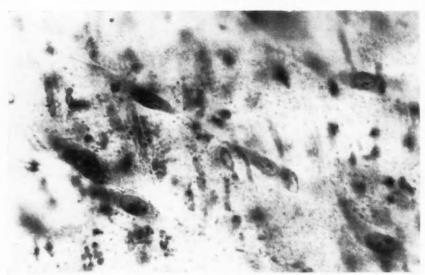
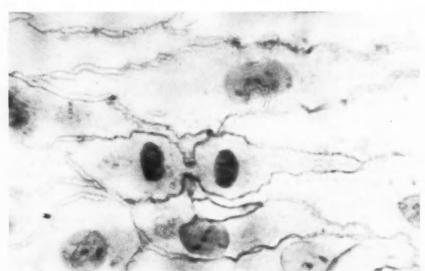


Fig. 11.- E n d o the lial cell mitosis at periphery of lesion, Argyrophilic lines participating in the development of the daughter cells. Silver nitrate and Harris's hæmatoxylin (x~1700).

#### INTERCELLULAR CEMENT

The intercellular "cement" substance, which according to Silver<sup>7</sup> was first demonstrated by V. Krause in 1843, has been the focus of conjecture and controversy. Its chemical nature has not been finally determined and there is even doubt (Sin-

apius<sup>8</sup>) that these lines represent cell boundaries. Our observations in the course of these experiments confirm the findings of those who have stained these "lines" with silver, heparin toluidin blue and indigo tetrasulphonate methylene blue, and in addition we have shown that they stain with



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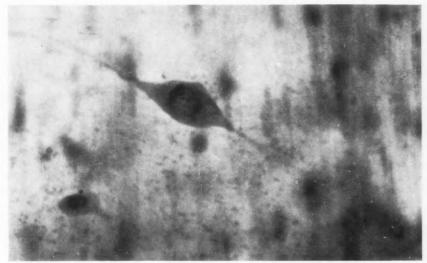


Fig. 13.—Mitosis of a fusiform cell on the surface of a lesion examined 48 hours after the application of 100 grams for one hour. Silver nitrate and Harris's hæmatoxylin (x 1100).

alcian blue. We cannot agree with the views of Sinapius, for in all the specimens that we have studied the relative positions of nucleus, surrounding cytoplasm and the "lines" suggest that the lines are, in fact, cell boundaries. We have rarely seen a line crossing a nucleus and seldom seen an empty space surrounded by lines. Further-

more, as demonstrated in Fig. 11, the "lines" have been seen to participate in the process of cell division just as a cellular membrane does, and in the dividing cells the cytoplasm which becomes "foamy" at the time of division is sharply bounded by these lines (Fig. 9).

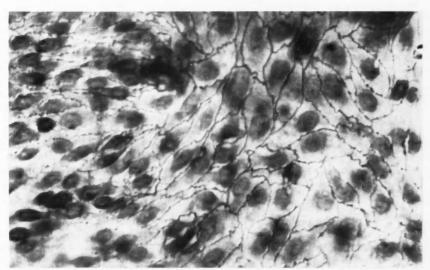


Fig. 14.—Irregularly arranged endothelial cells at a point where 96 hours previously 100 grams had been applied for one hour. Silver nitrate and Harris's hæmatoxylin (x 800).

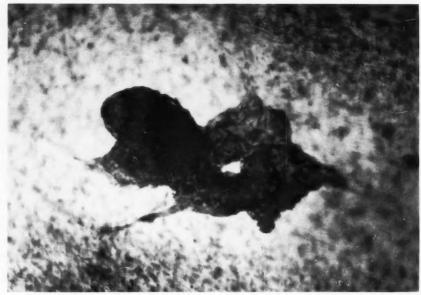


Fig. 15.—Endothelialized thrombus on the repaired surface of a lesion examined 72 hours following the application of 200 grams for three hours. Silver nitrate and Harris's hæmatoxylin (x 184).

The relationship of the argyrophilic lines found on the injured surface to the intercellular cement lines is not clear. The reason for their linear distribution at right angles to the long axis of the vein is that they lie in the troughs between the fibrils of the underlying circular muscles, for invariably they are to be found lying on either side of the elongated nuclei (Fig. 4) of the muscle cells.

## THE PARTICIPATION OF LEUKOCYTES AND PLATELETS

A prominent feature of the process after application of pressure was the appearance of leukocytes (predominantly polymorphonuclear) on the surface of the lesion and in the depths of the vessel wall. They appeared in profusion within three hours of removal of the pressure, but at 24 hours their number was greatly diminished. By this time the predominant cell was the monocyte. Of some interest has the silver staining film to be seen between white blood cells lying together, and occasional silver staining granules seen within the cells suggesting phagocytosis.

Platelets (verified in some instances by use of Wright's stain) appeared within three hours and were still present on the lesion in large numbers at 60 hours and occasionally (Figs. 9, 12, 13) at 72 hours. We have not seen platelets adhering to intact endothelium.

#### THROMBUS FORMATION

In approximately one-half the animals subjected to 100 grams pressure for one hour, structures that we judged to be thrombi formed. They consisted of amorphous masses of basophilic staining material with platelets and white blood cells and occasionally red blood cells enmeshed The incidence of thrombosis in animals subjected to a pressure of 200 grams for three hours was considerably greater, occurring in 27 out of 30. In some animals examined at 48 hours endothelialization of the thrombus could be seen with numerous endothelial cells undergoing mitoses cover ing its surface. The process of endothelial ization of the thrombi was complete in most of the animals examined more than 60 hours after the injury. In only one ani

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Fig. 16.—Lesion produced by the application of 600 grams for one hour to the abdomen of an anæsthetized rat, Small islands of undamaged cells are seen. Silver nitrate (x 60).

mal out of 74 in which thrombi developed was the lumen of the vein obliterated.

#### THE REPARATIVE PROCESS

With light pressure applied for a short time a recognizable lesion was regularly produced. It was characterized by the development of "harp-like" lesions on the surface without apparent disturbance of the underlying cell. Absence of this lesion in animals similarly treated but who lived for more than five hours after withdrawal of the pressure strongly suggested that the lesion was reversible. Greater pressure applied for longer produced an ulceration of the endothelial surface and the process of repair in these instances was, as described by Poole et al.,5 one of ingrowth of endothelial cells from the margin of the "ulcer". The earliest evidence of cellular activity was the appearance, within 24 hours, of nucleoli in the surrounding relatively undamaged cells with mitoses first observed at 48 hours, Fusiform cells (Figs. 12 and 13) believed to be migrating ingrowing endothelial cells were also seen on the surface of the lesion at 48 hours. Giant cells, as described by Poole, and as we have seen them in rabbits and humans, were rarely seen in the rats used for these experiments. Surface healing was complete by 96 hours in all veins subjected to a pressure of 100 grams for one hour.

#### DISCUSSION

It is possible that some cases of thrombophlebitis in humans can be traced to the effects of direct pressure upon the vein. Perhaps this is the mechanism in those instances where thrombophlebitis occurs in people who sit in a cramped position for a long time in air raid shelters, aeroplanes or even automobiles, or in those whose calves are compressed as they lie on an operating table. In the experiments described above, it has been shown that the slightest touch will produce a lesion of the endothelium and that a light weight (50 grams) applied for a short time (30 minutes) will frequently produce a thrombus while heavier weights will invariably do so if left on long enough. It has been shown too that pressure through the intact abdominal wall will produce endothelial damage and thrombosis in the vena cava.

Undoubtedly pressures of a type and degree equivalent to those used in these experiments must be exerted many times a day on the veins of even the most sedentary people and it is quite possible, even probable, that as a result of these unnoticed injuries the process of endothelial damage, thrombosis and repair is constantly taking

place in various parts of the body.

The fact that thrombophlebitis is not an exceedingly common disease suggests strongly that trauma alone, even though it readily induces thrombosis, is seldom sufficient to initiate the propagating thrombus that is the essential feature of thrombophlebitis. Some other factors, as yet unidentified, must be present to permit or to stimulate the progression of the thrombus that may be initiated by trauma.

#### SUMMARY

The effects of pressure applied to the external surface of the inferior vena cava of the rat have been observed and an estimate has been made of the degree and duration of pressure required to produce a recognizable lesion of the endothelium and to induce thrombosis.

This study was supported by a grant from the National Research Council of Canada,

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#### RÉSUMÉ

La cause de la thrombose veineuse est fo t mal connue; les modifications du courant sanguin, de la composition sanguine, et des altérations de la paroi vasculaire ont été invoquées, bien qu'à vraî dire on n'en sache guère plus long à l'heure actuelle qu'au temps de Virchow. La présente étude se propose d'observer les effets d'une con-pression appliquée directement sur la surface pression appliquée directement sur la surface externe des vaisseaux. Pour ce faire, on a utilisé 450 rats adultes de race Wistar, pesant entre 150 et 250 g. Après anesthésie, l'abdomen était ouvert sur la ligne médiane et la veine cave inférieure exposée; un petit appareil, spécialement conçu pour ce but, était mis en place, stérilement, sur cette veine, y appliquant une pression mesurable. Les veines étaient ultérieurement prélevées à des intervalles de temps variables, et fixées selon une intervalles de temps variables, et fixées selon une technique de perfusion de Mann modifiée. Des examens histologiques furent alors pratiqués

Les résultats peuvent être résumés comme suit: Faible compression, pendant un temps court.— Aucune modification n'est visible dans les veines ayant reçu une pression de 5 g. pendant 10 secondes. Des pressions de 10 g. appliquées pendant 30 secondes produisent des lésions discrètes, et probablement réversibles. Forte compression, appliquée pendant longtemps. - Il s'agit ici de poids de 100 et 200 g. appliqués pendant une et trois heures. On s'aperçoit alors qu'il se fait une destruction de l'endothélium, et qu'un petit thrombus se forme. La réparation peut parfois survenir, par prolifération des cellules endothéliales des bords de la lésion. Certains points en relation avec ces expériences (substance intercellulaire, formation du thrombus) sont alors discutés. Des conclusions, en rapport avec les phénomènes observés en clinique, sont apportées.

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### POLYPS OF THE RECTUM AND COLON IN CHILDREN A Ten Year Review at the Hospital for Sick Children, Toronto

A. S. MALLAM, M.R.C.S., L.R.C.P.\* and STUART A. THOMSON, M.D.,† Toronto

FECTAL BLEEDING in children still constitutes a problem in diagnosis and intestinal polyps account for 19% of the cases. Other frequent causes are enterocolitis, intussusception, Meckel's diverticulum and anal fishings.

Benign polyps in the large bowel account for 0.1% of all pædiatric admissions in the larger centres. The sex incidence shows a sight preponderance of males, of the order of 58%. The age group most commonly affected, as reported by most authors, lies in the two to six year range with the lower limit showing the highest individual incidence.

The great majority of patients have isolated polyps. The figure quoted from reported cases is around 80%, the remaining 20% being made up of patients with up to 10 polyps. Multiple polyposis is rare (Table I).

reports that 51% of all polyps seen in children (with less than 10 polyps) were within reach of the sigmoidoscope, i.e., within 24 cm. of the anus. Horrilleno, Eckert and Ackerman¹ reported that in their series 72.7% of polyps could be felt digitally per rectum (Table II).

Colonic polyps in children are distinguished from the adenomatous types found in adults by their unique microscopic structure and also by the patients' age differentiation. No comparable polyps are found in the teen-age group. The adult type appears at a later age, usually from the third decade on, and is composed primarily of proliferative glandular elements.

These childhood polyps are generally ovoid and flattened like a pod, while others may resemble a mushroom on a stalk. They are usually the same colour as the mucous membrane.<sup>4</sup> They may be pedunculated

TABLE I.—Number of Polyps per Patient\*

	Talal Ma	Sing	le	Multi	ple
Author and year	Total No. of cases	No. cases	%	No. cases	%
Horrilleno, 1 1955	55	40	72.7	15	27.3
Kennedy, 6 1931	49	34	70.8	14	29.2
Kerr, 7 1948	100	68	68.0	32	32.0
Harris, 5 1953	70	52	78.8	14	21.2
Castro, 4 1955	30	25	83.3	5	16.7
Furell and Maynard, 8 1956	68	56	82.4	12	17.6
H.S.C., 1959	183	137	74.8	46	25.1

\*This table is patterned after Horrilleno, Eckert and Ackerman.1

Polyps are most often found in the rectum, with the sigmoid colon as the next most frequent site. Thereafter, the descending colon, splenic flexure and transverse colon are about equally affected, after which the distribution trails off rapidly until the cæcum is reached. Patients with more than one and less than 10 polyps follow this general distribution. One author<sup>9</sup>

(75%) or sessile (25%). The size ranges from 0.5 to 3 cm., the greatest number being about 1.5 cm. in diameter. The stalks vary correspondingly in length and diameter, the average one being 1.5 cm. long. The consistency is firm and rubbery<sup>1,9</sup> while the surface may show evidence of erosion or ulceration, making it friable and giving rise to hæmorrhage. When they are situated in the rectum, prolapse of the polyp may occur through the anus. At any site, spontaneous amputation may occur from the passage of fæcal material and peristaltic action of the bowel. These last

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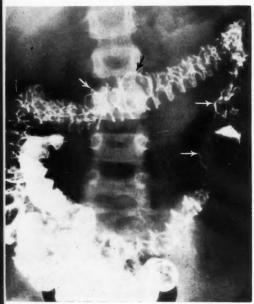


Fig. 1.—Post-evacuation air contrast study of colon showing polyps as ring shadows.

two factors may also be responsible for elongation of the pedicle.

The childhood-type polyp is relatively smooth in appearance and composed of connective tissue elements interspersed with areas of inflammation and necrosis, as evidenced by cellular infiltration with lymphocytes, plasma cells and polymorphonuclear leukocytes. The presence of eosinophils is a common characteristic. This inflammatory reaction with fibrin formation may obstruct the mucous glands of the polyp and give rise to dilated cystic spaces. The surface is invariably covered with granulation tissue, which bleeds readily. Gordon et al.9 formulate four criteria for malignancy, any three of which they consider sufficient evidence for a diagnosis of malignant change in an adenoma: "(1)

Stratification of epithelial cells with hyperchromatic nuclei; (2) mitotic activity; (1) absence of goblet cells; and (4) the presence of large nucleoli." In their series of 104 patients, they found nine (8.5%) who had one or more polyps showing malignancy, i.e., carcinoma in situ. Invasi e carcinoma was not encountered in any of 58 cases from which polyps could be examined. (The boundary line for invasion is the muscularis mucosæ or basement membrane.  $^{12}$ )

Familial tendency is difficult to assess and the evidence is not very conclusive, but it may be said that in cases with few polyps, the family history has no significance, whereas cases of multiple polyposis do occasionally show a familial trait.

Symptoms and signs of large bowel polyp are few, but rectal bleeding is complained of in 99% of cases. This may vary in degree from flecks of bright blood in the stools, and small amounts of blood associated with defæcation, to large amounts colouring the water in the toilet bowl. In rare cases, severe bleeding requiring blood transfusion may be seen. The passage of excessive mucus in the stools was reported by as many as 29% of patients in one series, although this figure is not confirmed by other authors.

Abdominal pain, usually described as cramps, occurs in about 20% of patients afflicted with polyps, according to the literature, but in this series the incidence was found to be about 5%. The pain is probably due to traction on the base of the pedicle during the passage of fæcal material and peristaltic activity.

Prolapse of rectal polyps is a variable feature, with a frequency ranging between 16 and 60%. In this series, prolapse was a sign in 24% of all cases, and constituted the second most frequent complaint of the child. Diarrhæa occurs in about 16% of

TABLE II.—LOCATION OF POLYPS\*

Author	No. of cases	Rectum	%	Sigmoid	%	$A  bove \ sigmoid$	%
Kennedy 6	49	39	81.3		Appendix.	4 .	8.3
Harris <sup>5</sup>	70	58	82.9	16	22.9	6	8.1
Castro4	30	19	63.3	4	13.3	5	16.
H.S.C	183	142	77.6	38	14.2	40	15.3

Percentages relate to total number of cases in each series.
\*This table is patterned after Horrilleno, Eckert and Ackerman¹.

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t d t e of reported cases and has a definite relationslip to the number of polyps present, being a major feature in cases of multiple polyposis (Table III).

Examination of suspected cases of intestinal polyps begins specifically with a digital rectal examination. As previously mentioned, one author reports positive findings from digital examination in 72% of his series. This is followed by a proctostopic and sigmoidoscopic visualization of the rectum and recto-sigmoid region of the ir testine following suitable bowel preparation. This examination, as also shown earlier, may be positive in up to 50% of cases.

The position of the patient for this procedure varies amongst operators. The prone jackknife position with the pelvis supported on a pillow is preferred by some, 10 or the knee-elbow position. The lithotomy position is recommended by others 3 since the majority of adenomas occur on the posterior wall of the rectum and pelvic colon and could be missed if the knee-elbow position is used. At this hospital, preference has developed for the left lateral or Sims position with the pelvis elevated on a sandbag.

Sigmoidoscopic examination is best carried out under general anæsthesia in children. Heavy sedation may be sufficient in older children, if indicated. For children under two years of age, an infant proctoscope may be used<sup>3</sup> but over this age the adult instrument is satisfactory.

The next step in the investigation is barium enema examination, and it is advisable to have an interval of at least 24 hours between sigmoidoscopic examination and this procedure during which the bowel



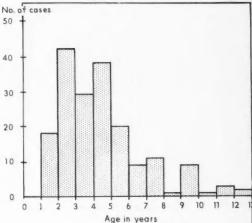


Fig. 2.-Age incidence.

is further prepared. A non-residue diet of clear fluids is given for the previous 24 hours with a dose of castor oil about 20 hours beforehand. This is followed by an enema or enemas till clear on the morning of the examination. The technique of this examination varies at different centres, but the most generally used method is single-contrast examination under fluoroscopy followed by post-evacuation air contrast studies and spot films. The polyps show up as ring shadows of increased density (Fig. 1).

Treatment of those polyps which lie below the pelvic floor consists of removal by means of cold biopsy punch or electrodiathermy snare, followed by electrocoagulation of the base with a ball-point

TABLE III.—SYMPTOMS AND SIGNS\*

TADI	LI III. DI	IMITOMS AND	DIGNO		
Author and year	No. of cases	Bleeding (%)	$Prolapse \ (\%)$	Abd. pain (%)	Diarrhæa (%)
Horrilleno, (1955)	55	55 (100)	34 (61.8)	10 (18.1)	3 (5,5)
Kennedy, 6 (1941)	49	43 (87.8)	14 (28.8)	13 (26.5)	8 (16.3)
Kerr, <sup>7</sup> (1948)	100	100 (100)	28 (28)	18 (18)	19 (19)
Castro, (1955)	30	(100)	5 (16.7)		
Gordon, 9 (1957)	104	99 (95.2)	19 (18.3)	(27.9)	26 (25)
H.S.C., (1959)	183	182 (99.5)	44 (24)	10 (5.5)	(3.8)

<sup>\*</sup>This table is patterned after Horrilleno, Eckert and Ackerman1.

TABLE IV.

Hospital	Incidence
Mayo Clinic (Gordon et al.) <sup>9</sup>	0.1%
H.S.C. Toronto	0 10%

electrode. For those polyps above the pelvic floor, laparotomy and transcolonic resection of the polyp is employed, after suitable bowel preparation. A useful adjunct to the location of polyps in the large bowel during laparotomy is the passage of a sterile sigmoidoscope up and down through a colotomy opening.

TABLE V.—Number of Polyps per Patient

No. of	pe	dį	17	08											Λ	V e	), (	of cases
	1			,			x									×		137
	2					á				,			į.					27
	3											·						11
	4																	5
	5			į	Ĺ	į			,				*	Ì	į			1
	5-	+																2
	T	ot	9	i														183

In cases of diffuse polyposis, segmental resection of the colon or subtotal colectomy with ileo-rectal anastomosis is performed. There is a risk of recurrence in the retained rectum and the possibility of carcinoma in later years but this is considered preferable to that of ileostomy. Careful follow-up is mandatory, and local recurrences in the rectum can be dealt with through the sigmoidoscope.

In some cases, where a few polyps are beyond the reach of the sigmoidoscope, it may be wise to wait for a year or two to observe the progress of the disease, in case it shows a vigorous recurrent tendency. One's hand may be forced by excessive bleeding, pain or diarrhœa. However, treatment should be completed one way or an-

other by the age of 15 years since the threat of malignancy is slight below this age.9

The recurrence rate is directly propertional to the multiplicity of the polyps, but there is always the possibility that some recurrences are unrecognized or missed polyps from a previous occasion.

Bush<sup>2</sup> describes a method of injecting India ink into the base of a polyp for future identification, but this procedure has not been popularized owing to the risk of perforation of the bowel wall with the needle tip when working at the far end of a proctoscope.

Complications, apart from massive hæmorrhage, are mostly those following operative procedures, such as perforation of the bowel wall during electrodiathermy. Adhesions and/or bowel obstruction may follow laparotomy, and evisceration and incisional hernia may likewise occur. The malignancy potential is extremely low.

#### PERSONAL SERIES

The study of rectal and colonic polyps at the Hospital for Sick Children was over a ten-year period from January 1948 to December 1957 inclusive, and involved 183 cases, an incidence of 0.1% of total hospital admissions over this period (Table IV). One hundred and five (57.4%) of these patients were males, which agrees with the findings of other authors.

The age group most frequently involved in this series was two to three years and the majority of cases were within the two to six year period (Fig. 2). The youngest patient was a boy of 14 months and the oldest a boy of 13 years.

Of the 183 cases studied, 137 had solitary polyps and only two had more than five

TABLE VI.—DISTRIBUTION OF POLYPS

Location	137 cases 1 polyp	27 cases 2 polyps	11 cases 3 polyps	5 cases 4 polyps	1 case 5 polyps	1 case 9 polyps	Totals	%
Anus	1	_					1	0.
Rectum	104	42	20	4	3	6	179	69.
Sigmoid	22	5	6	4		1	38	14.
D. colon	3	1	4	1	1	-	10	3.
S. flex	2	4	1	3	-	Automotion .	10	3.
T. colon	3	1	2	6	Name and Address of the Owner, where the Owner, which is the	and the same of	12	4.
H. flex		1	-	1	_	2	5	1.
A. colon	1	_	named in	1	e-manufacture (	_	2	0.
Cæcum	-		_	-	1	_	1	0.
Total	137	54	33	20	5	9	258	

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TABLE VII.—SYMPTOMS AND SIGNS

												No. of cases	%
Bleeding.	,									i		182	99.5
Prolapse.												44	24.0
ein												10	5.5
D arrhœa		*		į,	×	,					e	7	3.8

polyps. A further breakdown is shown in Table V. As regards distribution, 104 or the 137 solitary polyps (75.9%) were found in the rectum. It will also be noted that in the cases with multiple polyps the greater number are still found in the rectum (Table VI and Fig. 3).

In 60% of this series the polyp was reported as pedunculated, but this figure may not be too accurate because the point was not clarified in every case. The polyps varied between 0.5 cm. and 3.0 cm. in diameter, and except for two cases they were typical, as described earlier.

One of the unusual polyps was reported by the pathologist as a polypoid angioma and was fulgurated in the rectum of a four year old girl, whilst the other consisted of a stalk with eight tentacles arising from the transverse colon of a three year old boy. The latter was treated by resection

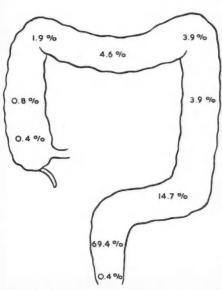


Fig. 3.—Diagram illustrating the percentage distribution of polyps in the Hospital for Sick Children series.



Fig. 4.—Octopus-like polyp of transverse colon.

of the colon with end-to-end anastomosis. The pathologist reported an adenomatous polyp (Fig. 4).

Family history was recorded as being positive only in three cases, one of which was a case of multiple polyposis, but this point was not stressed in the histories of more than a few cases as either positive or negative. Since the majority of cases were of solitary polyps, one may assume that the family history was of no significance except where recorded.

Of the symptoms, pain was found in only 10 cases (5.5%) whereas of the signs, rectal bleeding was prominent, being reported in 182 cases (99.5%). Prolapse was next in frequency, there being 44 cases (24%). Diarrhœa occurred in seven cases (3.8%) (Table VII). Digital examination of these children per rectum was recorded in 137 cases, with 81 positive results (59.1%). Sigmoidoscopy was performed in 168 with 136 positive findings. A barium enema examination was carried out in 125 cases with 95 positive reports and 30 negative findings



Fig. 5.—Polyp suspended through colotomy in sigmoid colon.

(Table VIII). It may be noted that polyps in the rectum are difficult to define during barium enema examination. In 29 cases an enema examination was performed after primary treatment and confirmed the effective removal of the polyps.

At this hospital, the method of barium enema examination is to run barium suspension containing 1% tannic acid into the colon under fluoroscopic vision as far as the hepatic flexure, care being taken to avoid descent of the barium into the cæcum. The patient then evacuates, leaving a coating of barium throughout the length

TABLE VIII.—Examination of Cases

Examination	No. of cases	Positive	%
Rectal	137	81	59.1
Sigmoidoscopic	168	136	81.0
Barium enema	125	95	76.0

of the colon. During evacuation, barium fills up the ascending colon and cæcum, but if the cæcum is previously filled, the barium is forced through the ileo-cæcal valve and fills the terminal ileum, thus obscuring definition of the colon during subsequent examination. After evacuation, air is pumped into the colon under fluoroscopy and frequent spot films are taken in anteroposterior and lateral projections (Fig. 1).

Treatment varied according to the site of the polyps; of this series of 183 patients, five passed their polyp spontaneously. Fifty-three cases were treated by causing the polyp to prolapse through the anus where it was ligated and removed. Eightyfour cases were managed by electro-cautery or snare through the sigmoidoscope and 47 cases required laparotomy, with trans-colonic polypectomy (Fig. 5). Before colotomy, the bowel is given a 48 hour preparation. For the first 24 hours, a low residue diet is given and a combination of succinvl sulfathiazole and neomycin\* is started orally to sterilize the bowel. Enemas are given each night and morning. Clear fluids are given for the second 24 hour period and the antibiotic is continued. On the morning of the operation, a Levin tube is passed for continuous gastric suction. The case with an octopus-like adenoma had a local resection of the colon with end-to-end anastomosis, and another one had a subtotal colectomy with ileo-sigmoid anastomosis (Table IX). This last case had five recurrences over an interval of four

TABLE IX

	TADIA TA.	
M	ethod	No. of cas
1.	Spontaneous passage of polyp	5
	Prolapse and ligation	
	Sigmoidoscopic electro-diathermy	
4.	Transcolonic polypectomy	47
5.	Bowel resection	1
6.	Subtotal colectomy	1

<sup>°</sup>Cremomycin (Merck, Sharp & Dohme): dose – infants 15-25 lb. 0.5-1 dram 4-hourly; children 35-65 lb. 1.5-2.5 drams 4-hourly.

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TABLE X.—RECURRENCE OF POLYPS

																N. C		$N\iota$	umber of pol	yps	
٧٠.	o,	f .	ce	ıs	es	3									re	No. of - ecurrences	1st rec.	2nd rec.	3rd rec.	4th rec.	5th rec.
				,				 								1	1	_	_	_	
																1	2	-		-	_
																2	1	1		-	-
																2	2	1	_	-	-
																5	8	3	7	7	18

years with up to eight polyps on each occasion. The removed specimen contained a further 18 polyps. Other recurrences were as follows: eight cases had one recurrence, six with one polyp and two with two polyps; three cases had two recurrences, two with one polyp on each occasion, and one with two polyps on the first and one polyp on the scond occasion. The shortest recurrence is terval was two months and the longest four years (Table X).

they are symptomless in the intervening period or before they reach 14 years of age, whichever is earlier. Patients with multiple polyps should be examined again in one year.

#### SUMMARY

In summary, 183 cases of rectal and colonic polyps have been studied and sufficient data have been accumulated to enable this childhood disease to be distinguished

TABLE XI.—COMPLICATIONS OF OPERATIONS FOR POLYPS-9 CASES

Perforated bowelBowel obstruction	2 cases	From electro-diathermy
Bowel obstruction	3 cases	1 month post laparotomy*
		2 months post laparotomy
		3½ years post laparotomy
Incisional hernia	2 cases	5 months after laparotomy†
		14 months after laparotomy†
Evisceration	1 case	at 10th day after laparotomy
Recurrent bleeding	2 cases	Further polyp concurrent with Meckel's
		diverticulum
		Associated with adhesions—laparotomy
Fæcal fistula	1 case	

\*Occurred in same case. †Occurred in same case.

The complications recorded in this series included three cases of bowel obstruction after laparotomy and colotomy; one at one month postoperatively, one at two months, and the third at three and a half years. Two cases of incisional hernia were noted. There were two cases of perforated bowel wall after electro-desiccation of polyps which necessitated laparotomy. One case of evisceration occurred on the 10th day after laparotomy and there was one fæcal fistula. There were two cases of recurrent one being from co-existent Meckel's diverticulum found at laparotomy while the other was due to adhesions with partial strangulation of bowel. There were no deaths in this series (Table XI).

The follow-up study of patients with single polyps should consist of a repeat barium enema examination and sigmoidoscopy in about four years' time, provided

from its adult counterpart and from typical familial polyposis. The investigation of these cases is outlined; a good prognosis can be offered in the vast majority of cases. The risk of malignancy is remote. Nearly one-fifth of all cases of rectal bleeding in children are due to polyps, and when one rectal polyp is found there is a 58% chance that it is an isolated one.

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#### RÉSUMÉ

Les hémorrhagies rectales posent toujours un difficile problème diagnostique chez l'enfant. La polypose bénigne du gros intestin constitue environ 0.1% des admissions dans les grands centres pour les affections des enfants. Les garçons présentent une légère prédominance sur les filles (58%): les ages varient entre deux et six ans.

Les polypes se trouvent le plus souvent localis s dans le rectum: viennent ensuite, par ordre ce fréquence: le sigmoïde, le descendant, le transver e et enfin le cæcum. Ces polypes sont généraleme it ovoïdes, ou ressemblent à un champignon; ils sont de même couleur que la muqueuse, et de co sistance ferme. Au microscope, ils sont form's de tissu conjonctif avec de grosses réactions inflammatoires, des zones nécrotiques, le tout enva il de lymphocytes et d'éosinophiles. La muqueuse qui les recouvre est souvent le lieu de formation ce kystes.

L'influence de l'hérédité reste problématique. Les symptômes se résument à peu de chose: dans 99% des cas, il n'y a aucun autre signe qu'un peu de sang dans les selles. Parfois des douleurs abdominales ou des crampes sont perçues; la diarrhee est généralement causée par une polypose multiple.

Le premier acte diagnostique est évidemment le toucher rectal, qui permet d'arriver à une décision dans 72% des cas. Il faudra ensuite procéder à une recto-sigmoïdoscopie sous anesthésie générale. Enfin il faudra faire un lavement baryté, après préparation soigneuse.

Le traitement variera selon le siège et nombre des polypes: la simple fulguration d'un polype isolé se fera à travers le rectoscope, s'il est situé assez bas; plus haut, il faudra procéder à une laparotomie et à une résection transcòlonique. En cas de polypose diffuse, des résections

côloniques segmentaires seront à envisager. Les auteurs étudient ensuite un ensemble de 183 cas de cette affection; ils ont pu ainsi dégager suffisamment de données pour distinguer cette maladie telle qu'elle se présente dans l'enfance, comparativement à ses formes adultes. Dans la très grande majorité des cas, le pronostic est bon, la polypose ayant peu de tendance à la malignité. Il faut se souvenir que dans les hémorrhagies rectales des enfants, il y a une chance sur cinq pour qu'il s'agisse d'un polype, et dans cette éventualité, il y a une chance sur deux pour que ce polype soit unique.

#### CLINICAL SCIENCE°

"The difficulty of applying scientific method to clinical practice is encountered by the undergraduate as he passes from the physiological laboratory to the wards. He finds that it is hard enough to measure even a superficial tumour, and that there aren't any instruments to estimate the hardness of a lump, or, more difficult still, to determine how ill a patient may be. In fact, those of us who believe in the importance of trying to preserve the scientific outlook which the study of physiology should have given them must be painfully aware of the impression they gain from watching their elders and betters at

work that inspired guesswork is a better bet than the methods of science.

"Trotter pointed out very clearly the conflict that exists between a practical art like surgery, success in which depends upon judgment, intuition, and skill, and the exactitude of science which demands the elimination of human facult. Yet this conflict must not be made the excuse for failing to make clinical methods as accurate as possible. The clinical scientist has to attempt o resolve the conflict by devising methods of ivestigation the results of which can be correlated with clinical observation. If he succeeds in this difficult task, and may thus appear to be redu :ing a scientific study to the level of 'clinical experience', it may be necessary to defend hin against the attack of the pure scientist who wou d depose clinical science from the dignity of being included among the true sciences . . .'

<sup>\*</sup>SIR JAMES PATERSON Ross: The scientific approach to surgery: The William Sheen Memorial Lecture delivered at the Welsh National School of Medicine, Cardiff, March 6, 1959, *Brit. M. J.*, 2: 27, 1959.

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## THE USE OF AN ISOLATED ILEAL LOOP FOR TOTAL REPLACEMENT OF THE URETER®

T. K. GOODHAND, M.D., W. E. ABBOTT, M.D.,
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THE PROBLEM OF REPLACEMENT of a segment of a damaged or congenitally deformed uneter has been receiving a great deal of a tention in recent years. The increasing frequency of radical pelvic surgery, with less of portions of the pelvic uneters has a so been a great stimulus for numerous investigators to find some method by which a damaged uneter can be replaced with preservation of a good functioning kidney above.

Damaged segments of ureters have been replaced by fallopian tubes, blood vessels and polythene tubing, but all these methods have been found to have very little long-term success. In 1912, Melnikoff¹ in St. Petersburg, published an article on ureteral replacement by an isolated loop of ileum. According to him the operation had been first performed by d'Urso and d'Fabii² on three dogs in 1900. One animal survived the operation, and showed a normal renal pelvis and ureter above the anastomosis at autopsy.

In 1909, the first recorded case in a human was reported by Shoemaker.<sup>3</sup> Bricker<sup>4</sup> added much more interesting information to the literature in 1952. His work created a great deal of interest and stimulated many more urologists to undertake this procedure and test its value.

In 1956, Moore and his associates<sup>5</sup> reviewed the literature on the use of isolated ileal loops for ureteral repair. Their review consisted of 20 cases published in the literature, and four personal cases. In the same year, Swenson<sup>6</sup> reviewed his personal experiences in children with megalo-ureter.

His method consisted of total replacement of one ureter in these small children by an isolated loop of terminal ileum, but he reduced the size of the ileal loop by resection of two-thirds of the circumference of the anti-mesenteric portion of the bowel. This was carefully closed, making a long thin tube. The purpose behind this procedure was to reduce the absorptive surface. During his investigation, he found that the method was satisfactory; in his opinion, peristalsis in the isolated segment was enhanced and absorption from the isolated loop was decreased.

In the last two years, numerous papers have been published illustrating the use of the ileum for partial or total replacement of the ureter or bladder. The purpose of the present experimental work was to test the feasibility of total ureteral replacement by an isolated segment of ileum, to explore carefully any biochemical or mechanical defects in the procedure, and to investigate the pathological changes in the kidney, ileal loop and bladder. We postulated that there would be fewer technical difficulties in total replacement of the ureter, rather than in partial replacement, because of the ease with which the small intestine can be anastomosed to the renal pelvis, a structure much nearer the size of the intestine itself.

The terminal ileum has been chosen as the ureteral replacement for several reasons: (1) Adequate blood supply. (2) Expendability and availability of a segment of the terminal ileum. (3) The presence of a mobile mesentery. (4) The presence of active peristalsis, which promotes the flow of urine distally.

Possible adverse effects are: (1) Ascending infection by reflux from urinary bladder. (2) Ascending infection from the bowel at the time of transplantation. (3) Excessive absorption of urinary electrolytes from the ileal segment.

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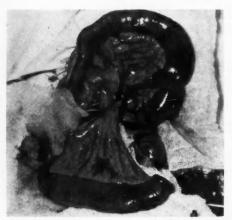


Fig. 1.—A loop of ileum of suitable length has been isolated, carefully preserving the blood supply in its mesentery. The continuity of the ileum has been re-established by an end-to-end anastomosis.

#### TECHNIQUE

The following experiments were carried out on mongrel dogs, under general anæsthesia. Early in our series, endotracheal ether-oxygen anæsthesia was used, but latterly all the dogs were given intravenous pentobarbital (Nembutal). The abdomen was shaved and prepared with pHisohex and Merthiolate, A left paramedian incision



Fig. 2.—The distal end of the isolated ileal loop has been anastomosed to the dome of the bladder,

was used. A piece of ileum of suitable length was first isolated, carefully preserting its blood supply. This isolated loop was then wrapped in a saline sponge. The continuity of the ileum was then re-established by end-to-end anastomosis, using two layers of chromic 4-0 catgut and reinforcing these two layers with one layer of interrupted 4-0 silk sutures (Fig. 1). The distallend of the isolated loop of the ileum was then anastomosed to the dome of the bladder by an end-to-side anastomosis using the same technique (Fig. 2).



**Fig. 3.**—This illustrates the method of passing the isolated loop of ileum through the mesentery of the descending colon.

Our next problem was to bring the proximal end of the ileum up to the kidney. Two methods were used. The ileum in some cases was passed through the mesentery of the descending colon and around its posterior surface to the posterior aspect of the kidney (Fig. 3). In other cases it was brought up to the kidney anterior to the descending colon.

At this point we encountered the most difficult part of this procedure. The kidney was mobilized and the pelvis of the left kidney identified. In the normal dog it is a small thin-walled structure, almost ontirely intra-renal. This made it exceedingly difficult to anastomose to a large ileum. As a result we adopted the following pocedure. The proximal end of the ileum v as

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closed with two layers of 4-0 chromic catgut. The ureter was then divided about one inch below the pelvi-ureteral junction. A small incision was made in the posterior will of the ileum and a fine Halsted forceps passed through the anterior wall, which would eventually lie against the posterior will of the kidney. The ureter was grasped b. this forceps and drawn into the ileum. A mucosa-to-mucosa anastomosis was then made between the pelvis and the anterior will of the ileum by interrupted 4-0 cl romic catgut sutures, in end-to-side fashion. As the pelvis was sutured, it was also divided in stages and at the end of the procedure the ureter was totally divided from the pelvis. The ileum was then situred to the posterior aspect of the kilney in order to relieve tension on the anastomosis. The opening in the posterior wall of the ileum was closed with chromic catgut and silk (Fig. 4). The kidney was then replaced in its normal position.

The urine was collected from the bladder and blood samples were taken for estimation of blood urea nitrogen, CO<sub>2</sub> combining power, serum chlorides, and serum potassium.

After intervals of four to 12 weeks, the dogs were anæsthetized with intravenous pentobarbital (Nembutal) and blood and urine studies were repeated. Intravenous pyelograms taken at the same time were used as an assessment of renal function.

The final part of the experiment was the removal of the normal right kidney. This left the animal totally dependent on its left kidney with an ileal ureter. This procedure was carried out on six dogs, at intervals varying from eight to 20 weeks after the initial ureteral replacement operation. At the end of this time, intravenous pyelography, estimations of blood urea nitrogen, CO<sub>2</sub> combining power and serum potassium and chlorides, and urinalyses were done to check the functional activity of the remaining kidney.

The animals were finally sacrificed at varying intervals, ranging from four and a half to 12 months from the time of the original replacement operation. Two other animals were accidentally killed by an overdose of Nembutal in the course of intravenous pyelography following the first



Fig. 4.—The anastomosis has been completed by carrying the ileal loop and its mesentery laterally in front of the descending colon. The ileal loop is seen anchored to the posterior surface of the kidney which had not been replaced in its normal position at the time the photograph was taken.

stage of the procedure. In both of these animals, the abdomen was opened immediately, and active peristalsis was noted in the ileal loop. Blood and urine samples were collected. The kidney, ileal ureter and bladder were removed intact for photographs, and the specimens preserved for histological study. Fig. 5 illustrates the kidney, ileal ureter and bladder, in position, immediately after the sacrifice of an animal. The mesentery of the ileal loop has been placed anterior to the descending colon.

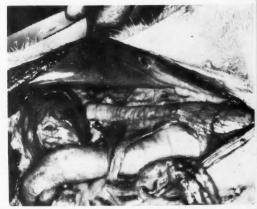


Fig. 5.—Post-mortem appearance of the kidney, ileal ureter and bladder. Note that the ileal loop has been carried anterior to the colon.

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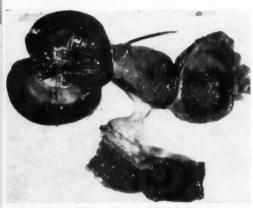
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Fig. 6.—Hydronephrosis due to pelvi-ileal obstruction. The pelvis bulges anteriorly, The ileal ureter and bladder have been opened widely.



Fig. 7.—The kidney is normal in size and colour. The ileal mucosa is normal, and there is no pelvi-ileal obstruction.



**Fig. 8.—**The kidney has been bisected along with the ileal ureter and bladder, and a probe passed through the pelvi-ileal anastomosis. The kidney parenchyma is normal.

#### TECHNICAL DIFFICULTIES

The technical difficulties of anastomosi g the small thin kidney pelvis to the small bowel have already been mentioned. In dogs 1 and 2, an initial ligation of the left ureter was done in order to produce a hydronephrosis. One week later the ileal replacement operation was performed, at d in both cases a grossly dilated renal pelvis was found, readily accessible for suture to the proximal end of the ileal segment. It was felt, however, that this possibly produced a partly impaired kidney. This initial step was dispensed with in the other cases.

#### RESULTS

This series consisted of 10 dogs, of which six underwent left ureteral replacement and right nephrectomy. In two of these animals an initial left ureteral ligation was performed. Four dogs had left ureteral replacement only. No biochemical studies were done on dog 10.

TABLE I.—POSTOPERATIVE URINALYSES

Dog No.	Turbidity	Mucus	Albumin	Pyuria	Spec. Grav.
1	++	++	+	++	1.009
2	++	++	++	_	1.011
3	++	++	++	-	1.028
4	++	++	+	Money	1.013
5	++	++	+	MERCHANI.	1.024
6	++	++	++	++	1.012
7	++	++	++	++	1.018
8	++	++	+	+	1.020
9	++	++	+	-	1.022

Urine was collected preoperatively in nine dogs and found normal. Samples were again collected at the time of sacrificing the animal and the findings are illustrated in Table I. It is interesting to note that in all cases the urines were turbid, all contained mucus, and all were positive or albumin. These findings are in agreement with those of other research workers, Four dogs had pyuria and in five the urine vas normal.

#### **Blood Chemistry**

Biochemical studies were carried out at four periods during the experiment, as follows: (1) At the time of original operation. (2) One week after original replarement of ureter by ileum. (3) One week after removal of normal right kidney. (4) At time of sacrifice.

TABLE II.—BLOOD UREA NITROGEN (NORMAL 6-22 MG.%)

Dog	No.	Pre- operative	Post left ureteral replacement	Early post nephrectomy	Late post nephrectomy
		27	13	165	152
		13	16	44	28
		12 13 27	27	34	28 24 25
		13	28	32 24	25
		27	21	24	21
		15	16	77	90
		28	27		
		15 28 25	24		
		21	22		

able II illustrates our findings in these an mals. The blood urea nitrogen level was co sidered normal at the time of the or zinal operation in all dogs, and remained so following the ureteral replacement. There was a rise in blood urea nitrogen following removal of the normal kidney. It will be noted that in animals 1 and 6 there was a marked elevation following removal of the normal kidney, and this persisted up to the time of sacrificing the animal. In both these animals, the left solitary kidney was hydronephrotic owing to pelvi-ileal narrowing. There was also an associated pyelonephritis in these two animals. The hydronephrosis was considered due to technical errors in both cases.

TABLE III.—SERUM CHLORIDES—(NORMAL: 99-108 MEq.)

Dog No.	Pre- operative	Post ureteral replacement	Early post nephrectomy	Late post nephrectom		
1	96	116	109.5	119		
2	104	104	109.5	109		
3.	102	113	108	108		
4	103	115.1	104	96		
5	103.5	111	106	109		
6	108	109.5	115	114		
7	108	104				
8	102	114				
9	102.5	114				

Table III illustrates the biochemical findings of serum chloride levels. No remarkable changes were noted in these

TABLE IV .- CO2 COMBINING POWER (NORMAL 25-34)

LADINE	11002	COMBINING	I OMER (140	MMAL 29-91		
Dog No.	Pre- operative	Post ureteral replacement	Early post nephrectomy	Late post nephrectomy		
1	26	26	27.5	14		
2	24	28	25.2	22		
23	24	24 36	27	21.5		
4	22	36	24	20		
5	31	30.2	29	21		
6	24	23.4	23.4	20		
7	28	26				
.27	23	26 26				
-61	25.8	24				

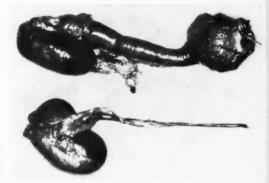


Fig. 9.—A comparison between the normal right kidney and the left kidney with its ileal ureter. There is no enlargement of the kidney. The ileal ureter was distended with water before being photographed.

observations except in dogs 1 and 6, in which the serum chloride levels were mildly elevated after removal of the normal right kidney.

Hyperchloræmic acidosis has been shown to be a constant complication of ureterosigmoidostomy (Table IV). Many variations in the technique of uretero-colic anastomosis have been tried to prevent ascending infection and the associated pyelonephritis in these cases. The commonly accepted belief is that the electrolyte imbalance in the patient is due to a combination of factors including urinary stasis with chloride reabsorption, and pyelonephritis with impaired kidney function.

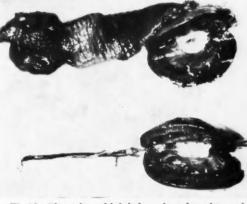


Fig 10.—The right and left kidneys have been bisected. Note the similarity in size and appearance. There is no change in the kidney with its attached ileal ureter.

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 $\textbf{Fig. 11.--} \textbf{Ileal loop} \ (x \ 300). \ The \ mucosa \ is \ relatively \ intact \ except \ for \ slight \ superficial \ atrophy \ and \ mononuclear \ cell \ infiltrate.$ 

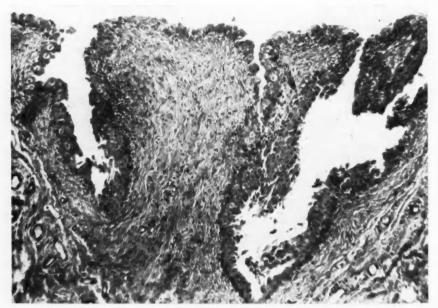


Fig. 12.—Chronic cystitis (x 300). Attenuated transitional epithelium thrown into irregular folds by underlying fibrosed connective tissue infiltrated by mononuclear cells.

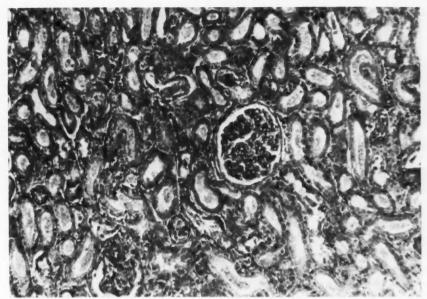


Fig. 13.—Normal kidney (x 210). Note intact glomeruli and tubules, and absence of inflammatory infiltrate.

Stamey and Scott<sup>7</sup> reviewed a small series of cases of prostatic carcinoma with obstruction and bilateral hydronephrosis. They found no evidence of pyelonephritis or dehydration in these patients, but all had marked hyperchloræmia.

In our series, the two dogs (1 and 6) that showed a tendency toward hyperchloræmic acidosis had no suggestion of ileo-vesical obstruction with urinary stasis, but both had pelvi-ileal anastomotic strictures with hydronephrosis and pyelonephritis. This would give the impression that the electrolyte imbalance depends mainly on the state of the kidney function, and that a normal kidney can readily adjust to any

electrolytic absorption that may take place in the ileal segment.

Intravenous pyelography was carried out in nine dogs before the right kidney was removed. It will be noted that good visualization was obtained on the left side in seven dogs, fair in two and poor in one (Table V).

At the time the animal was finally sacrificed, a careful note was made of the gross pathology of the left kidney, its ileal ureter and the bladder (Table VI). In three animals well marked hydronephrosis was present, and minimal hydronephrosis in two. In three there was a stricture at the pelvi-ileal junction. This is a mechanical

TABLE V.—Intravenous Pyelogram (Post Ureteral Replacement)

Dog No.										Left kidney visualization								
1																		Good
2																		Good
3																		Good
4																		Good
5																		Good
6								ě										Fair
7											é				8			Fair
8																		Good
9																		Poor
10																		Good

TABLE VII.-MICROSCOPIC PATHOLOGY

Dog No.	Kidney	Pelvis (with chronic pyelitis)	Ileum	Bladder (with chronic cystitis)		
1	Pyelonephritis	+	0	+		
2	0	+	0	+		
2 3 4 5 6	0	+	0	+		
4	0	+	0	0		
5	0	+	0	+		
6	Pyelonephritis	+	0	+		
7	Pyelonephritis with atrophy	+	0	+		
8	Focal pyelonephritis	+	Mucosal	+		
9	0	+	0	+		
10	Pyelonephritis	+	0	+		

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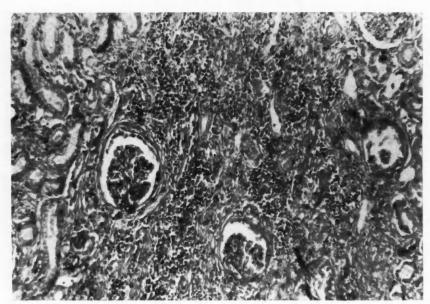


Fig. 14.—Chronic pyelonephritis (x 210). Prominent zonal interstitial mononuclear cell infiltrate, compressed and atrophic tubules, fibrosed and thickened Bowman's capsule, and few colloid casts.



Fig. 15.- Proximal anastomosis (x 210). Pelvi-ileal anastomosis is intact. The mucosæblend imperceptibly and no luminal obstruction is observed.

fault and in great measure a technical error due to the difficulty of anastomosing a very small kidney pelvis to a large ileum. In the human, especially when dealing with a hudronephrosis, this fault should not occur. The anastomosis between the ileum and biadder was perfect in all cases.

The result of mild obstruction at the plvi-ileal junction is shown in Fig. 6. The plvis is enlarged and bulges anteriorly. The ileal ureter and bladder have been opened. Note the normal appearance of the ileal mucosa. These organs are shown in

si u in Fig. 5.

Fig. 7 illustrates a normal kidney, ileal u eter and bladder. The kidney is normal in size. The ileal ureter and bladder have been opened. On cut section (Fig. 8) these is no thinning of the kidney parenchyma. The pelvis is normal. A probe lies in the ureter and extends through the pelvisibal junction into the renal pelvis. Note the normal ileal ureteral mucosa. A portion of the ileum at the site of the original end-toend anastomosis is left attached for comparison.

Figs, 9 and 10 illustrate the similarity in size and gross appearance of the right and left kidneys in a dog accidentally killed while undergoing intravenous pyelography under pentobarbital (Nembutal) anæsthesia. No pathological change was found in the kidney with the ileal ureter, and no pelvi-ileal stricture was present.

In reviewing the histology of the ileal segments (Table VII) it was interesting to note that the ileal mucosa remained relatively unchanged even in dogs kept 12 months after ureteral replacement (Fig. 11). Some mucosal flattening was noted with focal collections of chronic inflammatory cells, but the con tant flow of urine appeared to be very well tolerated by the ileal mucosa.

The urinary bladder in all cases showed collections of submucosal chronic inflammatory cells. Fig. 12 represents a chronic low-grade infection. The gross and microscopic pathological findings were very similar in dogs with or without pyuria, which in our opinion was very interesting.

In five dogs the kidney histology was perfectly normal (Fig. 13). In three dogs (dogs 1, 7 and 10) well-marked pyelo-

TABLE VI.—GROSS PATHOLOGY

Dog	No	),					Hydro- nephrosis	Pelvi-ileadobstruction	l Ileo-vesical n obstruction
	1.			,		,	++	+	0
	2.						0	0	0
	3.						+	0	0
	4.						0	0	0
	5.						0	0	()
	6.						++	+	0
	7.						+++	+	0
	8.						+	0	0
	9.		ĺ,				0	0	0
	10.		•			,	0	0	0

nephritis was present (Fig. 14), which in two of these cases was associated with pelvi-ileal obstruction and hydronephrosis. Fig. 15 illustrates the histological appearance of a normal pelvi-ileal junction. It is interesting to note that in three cases with pyelonephritis, the corresponding ileal ureters were quite normal. We therefore believe that the kidney infection was most likely due to obstruction rather than an ascending infection through the widely patent vesico-ileal anastomosis.

### Conclusions

An isolated ileal segment is a satisfactory replacement in cases of ureteral damage. Total ureteral replacement is probably more satisfactory than partial replacement, because of the comparable size of the kidney pelvis and the ileum.

The mucous secretions from the ileal segment do not appear to be a problem except that they produce a persistent proteinuria.

Peristaltic activity of the isolated loop was observed to be retained in two dogs accidentally killed by an overdose of pentobarbital (Nembutal) during intravenous pyelography. This corresponds to the observations of Swenson and Fisher, and would tend to prevent reflux and ascending infection from below. The rapid passage of urine along the ileum might also account for the minimal electrolyte reabsorption.

Hyperchloræmic acidosis is most likely due to impaired kidney function, rather than excessive chloride reabsorption by the ileal segment.

Chloride reabsorption by the ileal segment is not a problem in this procedure as it is in uretero-sigmoid anastomosis.

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Careful histological studies of the kidney, ileal ureter and bladder are presented.

No histological change is seen in the ileal ureter after constant exposure to urine over long periods of time.

This work was carried out on a grant from the Banting Research Foundation, whose aid we acknowledge with thanks. All histological studies were done in the Department of Pathology of St. Boniface Hospital. We wish to thank Dr. Hamonic for his co-operation and detailed pathological reports. Mr. L. Stanford, in the Photographic Department of St. Boniface Hospital, was our photographer. His co-operation is much appreciated. Pyelographic studies were contributed by the Department of Radiology, Winnipeg General Hospital. We wish to thank Drs. Osberg and Campbell for their aid. The biochemical studies were carried out jointly in the Biochemical Laboratories of the St. Boniface Hospital, and the Winnipeg General Hospital.

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### RÉSUMÉ

La fréquence toujours croissante des cas de chirurgie élargie du bassin pose avec plus d'acuite le problème du remplacement d'une portion d'ure tère. Le remplacement par des trompes utérine des vaisseaux sanguins, des tubes de polythène été essayé, avec des résultats décevants à long terme. Il semble que ce soit en 1900 que, pour la première fois, on a fait des tentatives expérimen tales de transplantation d'intestin grêle.

Les auteurs décrivent alors la technique qu'ilont employé expérimentalement dans un essai de
remplacement d'une portion d'uretère par unanse d'iléon. Ces expériences furent conduites chezdes chiens, sous anesthésie générale à l'éther ou
au pentobarbital. L'abdomen est ouvert selon une
incision paramédiane gauche; une anse d'intestin
grêle est isolée, tout en conservant soigneusement
ses connexions vasculaires et mésentériques. Une
anastomose est alors pratiquée entre ce segment
d'iléon d'une part, et le bassinet ou l'uretère
d'autre part: la minceur de ces structures, chez
le chien, et leur disposition anatomique présentent
des difficultés particulières.

Ultérieurement, les urines furent analysées et, après des périodes variant entre quatre et douze semaines, des pyélographies intraveineuses furent pratiquées. La partie finale de l'expérience fut l'ablation du rein droit afin de laisser l'animal sous la dépendance totale de son anastomose. Les épreuves de laboratoires furent alors répétées, et après 12 mois les animaux furent sacrifiés.

Les résultats, donnés sous forme de tableaux, peuvent être résumés comme suit: un segment d'iléon isolé constitue un excellent moyen de remplacer un uretère partiellement ou totalement endommagé; les sécrétions muqueuses de l'iléon provoquent une albuminurie permanente sans inconvénient; les réabsorptions de chlorures dans l'iléon ne posent aucun problème, contrairement à ce qui se passe lors des anastomoses dans le sigmoïde; enfin, les contrôles histologiques ne révèlent aucune modification aux niveaux de l'iléon, du bassinet, de l'uretère, de la vessie ni du rein.

## COLO-CYSTOPLASTY

Surgeons at a Paris hospital (*J. Chirurgie*, 77: 423, 1959) describe a technique of colo-cystoplasty. They state that after having been partial to performing ileo-cystoplasty, they abandoned the use of the ileum in January 1957 and substituted a section of colon. They no longer regard the two objections to the use of colon—poor vascularization and sepsis—as of importance. Moreover they consider that these risks are outweighed by the occurrence of obstruction after ileo-cystoplasty, for colo-cystoplasty is essentially a pelvic operation and the newly-fashioned bladder is situated in a cavity completely outside the peritoneal cavity.

They describe their technique of transpertoneal colo-cystoplasty in the male and in the female. They have now performed the operation 37 times for vesical destruction due to tuberculasis, bilharziasis, carcinoma, or vesico-vagini fistula. Two patients died, one due to carcinoma and the other because of pulmonary embolism. In nine cases there was some urinary leakage which soon stopped. In two cases an intestinal obstruction occurred; in one case a uro-fæcul fistula formed but closed after colostomy. Comparison of results in this series with those in 16 cases of ileo-cystoplasty make the authors feel that this employment of a segment of sigmo dicolon is preferable to that of ileum.

# ILEOCYSTOPLASTY A. EXPERIMENTAL STUDIES ON ELECTROLYTE BEHAVIOUR®

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THE FIRST ILEOCYSTOPLASTY performed here vas in February 1955, since which time 18 operations have been performed in which an isolated loop of ileum has been used to replace the ureter, the ureter and most of the urinary bladder, and in a few instances to replace the entire urinary bladder, but in all cases leaving the patient's own urethra as the final exit of urine from the body. In the first section, we wish to report experimental data concerning electrolyte and water changes in isolated ileal loops; in a second section, our clinical experience with ileocystoplasties in respect to surgical features and also observations on metabolic aspects of this form of urinary tract replacement will be reported.

The problem of biochemical disturbances after urinary diversion operations, where a part of the intestinal tract is substituted for the sacrificed bladder, has been widely known since Ferris and Odel's1 publication in 1950. These authors reported hyperchloræmia and acidosis in 80% of patients at various periods after bilateral ureterosigmoidostomy was performed. Another biochemical disturbance was reported the same year, Foster, Drew and Wiss2 reported a case of potassium deficiency and hyperchloræmic acidosis after ureterosigmoidostomy. Since then a great amount of both clinical and experimental work has been done to elucidate this problem and describe the pathogenesis.

Parsons, Powell and Pyrah<sup>3</sup> published results of comparative urine studies in a case of unilateral ureterosigmoidostomy and proximal colostomy with an intact urinary system on the opposite side. They also reported the changes in urine after urine enemas. Annis and Alexander<sup>4</sup> also gave

urine enemas and obtained results similar to those of the previous authors. Again Pyrah et al.5 studied the migration of sodium, chloride and potassium ions across the ileum by radioactive isotope methods. All this experimental work agreed on the pathogenesis of the hyperchloræmic acidosis. It was seen that chloride was absorbed at a higher rate than sodium and that the urine after being in contact with the bowel became alkaline. In urine enema experiments, potassium concentration before and after did not change appreciably, but with isotope work on the ileum, it was shown that when potassium concentration was three times that in the blood, which it usually is, potassium was absorbed from the ileum, Stamey,6 in an excellent review of the subject, introduced the concept of constant hypertonic sodium chloride infusion producing diuresis with consequent dehydration and potassium loss. Wilkinson,7 in 1952, also suggested the constant washing off of intestinal secretions by the urinary flow as another cause of potassium loss. Pers<sup>8</sup> studied the absorption of urine in the colon in dogs and, besides confirming the previously stressed excessive chloride absorption, emphasized the importance of the concentration of the urine in this respect. This work is so similar to our own in methods and results that further reference will be made to it in our discussion.

The ureterosigmoid transplant operation, besides its dangers of postoperative acidosis and potassium depletion, also carries with it a high incidence of pyelonephritis due to fæcal contamination and reflux up the ureters. In view of this fact, surgeons in recent years have used isolated loops of ileum as a bladder substitute. On this continent, Bricker<sup>9</sup> in 1952 reported the results of 55 operations, where the ureteroileal anastomosis was performed with a blind ileal loop, whose distal end was brought to the skin in an ileostomy. There was only one case of hyperchloræmic acidosis. In this type of operation, naturally,

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the ileum does not function as a bladder but as a conduit to the urinary flow. All reports since indicate that the ileum is a better substitute and causes less electrolyte imbalance than ureterosigmoid transplant.

With ileocystoplasties as described by Cibert, Couvelaire, Pyrah and others, in which the ileum is connected to the bladder neck after a subtotal cystectomy, the ileum is used not only as a conduit but also as a reservoir; a longer loop of ileum is also required and as the operation is frequently performed for patients with a long-term prognosis we have considered it necessary to study the metabolic changes so produced as an indication of possible complications to be expected in these patients in future years, their mechanism and prevention, and possible limitations in the application of such replacement surgery. Already a clinical follow-up of patients who have undergone ileocystoplasty has demonstrated varied degrees of hyperchloræmia and potassium depletion. One patient became severely acidotic with an estimated 40% loss of total body potassium. Others have been well maintained on restricted salt diet with or without supplements of sodium and potassium citrate.

The purpose of our investigations has been to determine the rate and extent of absorption of urinary constituents from the ileum, in an effort to elucidate the pathogenesis of hyperchloræmia and potassium depletion in these patients.

### METHODS

Dogs were operated upon under pentobarbital (Nembutal) anæsthesia and approximately 18 inches (45 cm.) of terminal ileum was isolated. Continuity of bowel was restored by end-to-end anastomosis. The proximal end of the isolated segment was closed and the distal end was brought to the skin. About one week after the operation, experiments were started. The majority of experiments were on two dogs who had satisfactory blind ileal loops. Under light thiopentone (Pentothal) anæsthesia, 50 c.c. of urine (or appropriate solutions) was instilled into the blind loop with a syringe and catheter. The catheter was not removed and the solutions were recovered

after 60 minutes. The samples of the dog: own urine were collected-or fresh specimens of other dogs' urine-and diluted to various concentrations. In addition, artificially prepared solutions of sodium chloride, potassium chloride, and urea or human urine samples were also diluted to desired concentrations. Volume, specific gravity, pH, sodium, potassium, chloride and ure i content of both instilled and recovered specimens were measured. Specific gravit; was measured by an ordinary urinometer at 15°C. The pH was measured at 25°C. using a Radiometer pH meter 22. Urea was determined by the method of Van Slyke and Cullen, 10 chlorides by the mercurometric titration method of Schales and Schales,11 sodium and potassium by an Eel flame photometer.

The recovered specimen contained a fair amount of mucus which was accounted for in measurements of volume, specific gravity and pH. The specimen was then centrifuged and the mucus separated. Electrolytes were determined on samples free of mucus. On a number of occasions the mucus was repeatedly washed and hydrolyzed and electrolytes were determined in the hydrolysate. It was found that the electrolyte content of the mucus in the amounts obtained was too scanty to influence our results of net changes between the urine inserted and urine recovered. The soluble part of intestinal secretions is accounted for in the recovered specimen, since the ileal loop was not irrigated before instillation of urine.

### RESULTS

The results of absorption in the initial phase of the experiments could not be correlated with the concentration of the different electrolytes. It was noticed, however, that the rate of absorption of electrolytes was dependent not only on their concentration, but also on the volume changes during the experiment. Since the changes of volume depended closely on the specific gravity of the urine inserted, we have civided our results into two groups: (1) Results with urine of high specific gravity; (1) Results with urine and solutions of low specific gravity, the determining point be

tween the two groups being taken as the specific gravity at which no volume changes (ccurred.

Solutions made up to simulate urine, containing sodium chloride, potassium chloride and urea at various concentrations, were found to follow the same pattern of absorption as their corresponding urine samples when grouped with urines of low specific gravity.

This method of grouping is naturally a rough one. A more accurate means of sudying the subject would have been to determine the osmotic pressure of each simple, since the specific gravity in a complex solution like urine only roughly a rallels osmotic pressure. Further accuracy would also have been achieved by studying absorption rates at different concentrations of electrolytes but at the same osmotic pressures, and at different osmotic pressures but similar concentrations. We feel, however, that even with its limitations this will serve to demonstrate the variations of absorption rates.

(a) Volume changes.—Fig. 1 is a graphic representation of the volume changes that occurred at different specific gravities of urine or solutions put into the blind ileal loop for 60 minutes. Although the general pattern of the graph suggests a simple diffusion pattern, there is a variation of 0.008 specific gravity points between the two extremes. The reasons for this variation have been looked into. The factor of time after operation, bringing in the possibility of adaptation of the ileal mucosa, was considered. Differences between the animals used were also taken into consideration. Neither of these factors correlated with the variation. The variation in osmotic pressure between urines of the same specific gravity is a major factor but, since osmotic pressures were not determined, it is difficult to assess this point. However, besides the factor of experimental error, this seems to be the best explanation.

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It is apparent from this graph that with urines of high specific gravity the overall result of water movements across the ileal nucosa is in favour of water passing into the lumen, ending in volume increase (secretion), whereas with low specific

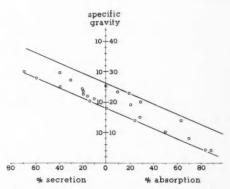


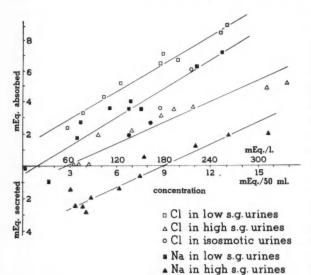
Fig. 1.—Changes in volume of urine put into dog's ileum for 60 minutes.

gravity urines it is the opposite, ending in volume decrease (absorption).

(b) Specific gravity and pH changes.— It was found that the specific gravity of the recovered sample in all cases measured was lower than initial specific gravity and tended to be between 1.010 and 1.017, with only one exception, In all experiments the changes in pH were towards 7.4. This was true for both acid and alkaline urines.

(c) Sodium and chloride absorption.— Chloride absorption was found to depend on its concentration and the specific gravity of the urine (Fig. 2). In both groups of urine the absorption increased with increase of concentration of chloride. There was no evidence of chloride secretion in any experiment. There was a marked difference of net amount absorbed between high and low specific gravity urines. Chloride in low specific gravity urines was absorbed more than twice as much as chloride in high specific gravity urines at the same chloride concentration.

Sodium was found to follow the same pattern of absorption as chloride but at a lower rate. In all concentrations and both groups, sodium was absorbed less than the corresponding chloride concentration. In both low and high specific gravity urines, sodium was found to be secreted in the recovered specimen below a certain concentration. These threshold values were around 50 mEq/l. for low specific gravity urines, and around 160 mEq/l. for high specific gravity urines (Fig. 2). For both



 Na in isosmotic urines
 Fig. 2-Absorption of sodium and chloride in low and high specific gravity urines in 60 minutes.

groups the absorption rates of sodium and chloride were closely parallel, so that almost in all instances the net difference between absorbed chloride and sodium was constant. Consequently at high absorption rates, the ratio of the net difference to net amount absorbed is smaller than at low absorption rates.

(d) Potassium and urea absorption.—Potassium was found to be absorbed in all experiments at the concentration used. The rate of absorption varied in the two groups, low specific gravity urines having a higher rate than high specific gravity urines. The absorption rates were similar to the sodium and chloride absorption curves. Urea was absorbed in all experiments. There was a slight decrease in the rate of absorption with high specific gravity urines as compared to low specific gravity urines. In both groups, however, the absorption rate was in linear relation to concentration.

# DISCUSSION

The above results are in agreement with other experimental work done on absorption from the ileum. Visscher and associates<sup>12</sup> demonstrated that the net movement of water from the gut to blood depends,

in general, in direction and magnitude on the osmotis pressure. This does not hold true, however, for solutions of isotonicity which are alsorbed, although the osmotic pressure may be negative. He also demonstrated, by use of radioactive sodium and chloiide, that the concentration of sodium and chloride moving into the lumen was independent of the concentration of solution in the gut, and was constant at around one-fourth of the serum value. On the other hand, the concentration of sodium and chloride moving from the lumen to the blood was in direct linear relation to the concentration of sodium and chloride in the solution in the gut. When these findings are applied to

urines with the same concentration of sodium and chloride but different specific gravities, our findings of less absorption in high specific gravity urines are readily explained. In high specific gravity urine, the net water movement is towards the lumen; this water has a constant low concentration of sodium and chloride. Although in linear relation with the concentration of gut fluid, water and sodium and chloride are moving towards the blood simultaneously; the predominant movement being towards the lumen, the net absorption is modified, resulting in comparatively less absorption. On the other hand, at the same concentration of sodium and chloride but with a low specific gravity urine, the net direction of water movement is towards the blood. This carries with it a proportionately high sodium and chloride concentration. The modifying action of water movment towards the lumen is ineffective n this case, since this movement is small n magnitude, the result being a high r absorption rate than with high specific gravity urine at the same sodium and chloride concentrations.

The same explanation is also valid for potassium and urea absorption, since bo h

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these substances have low serum concentrations.

Although in Visscher's paper<sup>12</sup> there are 10 numerical values showing the sodium concentration of water moving into the limen to be higher than the chloride concentration, studies in the composition of intestinal secretion in the ileum by De Beer and associates<sup>13</sup> show sodium concentration to be twice as great as chloride concentration. This fact is offered as one explanation of the seemingly selective absorption of chloride over sodium at the same concentration.

The results of this study are closely parallel to the results obtained by Pers<sup>8</sup> for eabsorption of urine in the colon. The fate of urinary potassium seems to be the only difference in the absorption of urinary constituents between ileum and colon. Pers has not found any difference of potassium concentration between urine specimens introduced into and recovered from the colon. We, on the other hand, have observed a constant reabsorption in all experiments. The same difference between colon and ileum in this respect can be seen in all experimental work that has been performed. The results of urine enemas described by Annis and Alexander<sup>4</sup> do not show any significant changes in before and after specimens, Small variations showed a secretion of potassium. Parsons, Powell and Pyrah's3 urine enema experiments gave the same results. On the other hand, the studies of Pyrah, Care, Reed and Parsons<sup>5</sup> with radioactive sodium, chloride and potassium of absorption in ileum showed that potassium was absorbed when its concentration in the ileum was more than three times that of the blood. Our results confirm this fact.

### Conclusions

The experimental findings of this study provide clues for a discussion of the pathogenesis of the biochemical disturbances that occur in patients with an ileocystoplasty.

Dehydration is naturally of primary importance. Although with low specific gravity urine a considerable amount of water is reabsorbed, calculations of sodium

chloride concentrations of the absorbed solution reveal that above a specific gravity of 1.010, the absorbed solution is hypertonic. This hypertonicity increases with higher specific gravities and higher rates of sodium chloride absorption. This constant infusion of hypertonic solution, if not accompanied by a high water intake, will result in a concentrated urine and this in turn will cause absorption of more hypertonic solutions, and a vicious cycle may result in severe dehydration. It is a frequent clinical observation to see these patients with a voluntary water intake of three and four litres per day. A number of these patients who have had the operation for tuberculous contracture of the bladder have poor kidney function, with a fixed specific gravity of 1.012-1.014. So far as dehydration is concerned, these patients should be better equipped to handle the problem.

In the pathogenesis of hyperchloræmic acidosis the experimental results confirm the hypothesis of excessive chloride absorption over sodium absorption. The changes in pH also demonstrate the post-renal gain of H ions. The lessened alkalinity of the recovered sample in the experiments where the initial urine was alkaline is difficult to explain. It should be stated here, however, that alkalinity of those urine specimens was due to breakdown of urea to ammonia during collections of urine from dogs; they were not truly alkaline.

The demonstrated differences of sodium and chloride absorption in high and low specific gravity urines will at first glance make one feel that these patients would do better secreting a urine of high specific gravity and low salt content. However, since the net difference between absorbed chloride and sodium can be accepted as the cause of the biochemical disturbances, calculations of these in different types of urine is necessary to give a truer picture. Calculations shown in Table I demonstrate that the magnitude of the net difference between chloride and sodium is at its lowest in urine of low specific gravity and high salt content. This type of urine, however, is unphysiological and unobtainable in patients with diseased kidneys. The next

TABLE I.—CALCULATIONS OF NET DIFFERENCES IN ELECTROLYTE ABSORPTION WITH DIFFERENT TYPES OF URINE

Type of urine	Net (Cl-Na) absorbed	Water		
Low sp.g. Low conc. of NaCl (50 mEq./l.)	(2.1)- $(0.5)$ - $1.6$ mEq. of Cl absorbed in excess of Na	Absorbed		
Low sp.g. High conc. of NaCl (250 mEq./l.)	(8.2)-(7)-1.2 mEq. of Cl absorbed in excess of Na	Absorbed		
High sp.g. Low conc. of NaCl (70 mEq./l.)	(0)-(-2.5)-2.5 mEq. of Na secreted in excess of Cl	Secreted		
High sp.g. High conc. of NaCl (250 mEq./l.)	(4.2)-(1.5)-2.7 mEq. of Cl absorbed in excess of Na	Secreted		

"safe" urine is a low specific gravity urine of low salt content.

Our experimental results demonstrate that the cause of potassium depletion cannot be in the ileal bladder. It is also an established fact that potassium depletion does occur in patients with ileocystoplasties. Potassium depletion in patients has always been accompanied by hyperchloraemic acidosis and dehydration. The relation of acidosis and potassium loss as cause and effect, however, is contrary to Berliner's<sup>14</sup> hypothesis of relationship between potassium metabolism and acid-base balance. If these patients are acidotic, the potassium excretion will diminish unless there is advanced kidney dysfunction.

Dehydration preceding the acidosis, however, will tend to increase the potassium excretion. Mudge and associate; <sup>15</sup> have demonstrated the relation of potassium excretion and cellular hydration. Experiments on dogs dehydrated with hypertonic sodium chloride infusions demonstrated increased potassium excretion with evidence of active tubular secretion of potassium. The similarity of results in these experiments and in ileocystoplasty patients is evident.

It remains to be shown that the same pattern and the same rates of absorption apply to the human ileum, Observations on this will be reported in a second section.

In view of these findings, how can patients with ileocystoplasties be helped to prevent biochemical disturbances? It is evident from the conclusion drawn that these patients should have a high water and low salt intake. This will ensure a low specific gravity urine of low salt content. The net difference between absorbed

chloride and sodium can further be diminished if the urinary sodium concentration is higher than the chloride concentration. The graphs in Fig. 2 show that chloride and sodium absorption in urine of low specific gravity will be equal if the sodium concentration is 40 mEq/l. higher than chloride concentration. Therefore supplementary sodium in the form of sodium bicarbonate, citrate, etc., may be added to the diet.

At the present, in view of the possibilities of acidosis and potassium depletion, patients are being given mixtures of sodium and potassium citrate as a compensatory measure. Our results show that supplementary potassium is not necessary if adequate water intake is provided. It should be borne in mind that excessive alkalinization of the urine may also result in excessive potassium secretion by the kidney. However, in view of the absorption rates of potassium from the ileum, even high concentrations in urine should not be contributory to potassium depletion, but by and large, only increase the potassium turnover. We would be justified therefore in advocating supplementary sodium in effective doses.

### SUMMARY

The first section of this publication deals with experimental studies on dogs of the changes in urine instilled into isolated loops of ileum. The results are related to experimental data and clinical observations reported in the literature, as well as our own clinical experience which will be reported in detail in a second section.

It was found that the change in volume of urine instilled into a blind ileal loop

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depended on the specific gravity of the urine, low specific gravity urines being real sorbed and high specific gravity urines being diluted by secretion into the loop. Specific gravity of the instilled urine became lower, tending to reach levels of 1.110-1.017. The pH changes were towards 7.4.

Sodium and chloride absorption varied with the concentrations of these electrolytes for urines of similar specific gravity, but wis greatly modified by alterations of urine specific gravity. For the same concentration of sodium and chloride, high specific gravity urines showed much less absorption than low specific gravity urines. The ileum reabsorbed more chloride than sodium at all concentrations of these electrolytes and regardless of specific gravity. Only if the concentration of sodium was 40 mEq/l greater than that of chloride was the reabsorption of these ions equal.

Potassium and urea are both reabsorbed in linear relation to their concentration, and more from low specific gravity urines than from high specific gravity urines.

Our results are in agreement with the reports of others describing a two-way movement of ions and water across the intestinal mucous membrane. The movement of water with sodium and chloride into the lumen modifies the reabsorption of these ions from the lumen in high specific gravity urines but less so in low specific gravity urines, the greater movement of sodium than chloride into the lumen accounting for the net increase in chloride reabsorption. The results are similar to those in reported experiments on the colon, except for potassium which is reabsorbed by the ileum.

The pathogenesis of hyperchloræmic acidosis when it does occur with the use of ileum in the urinary tract is similar to that in uretero-colic anastomosis. The dehydration produced by the hypertonic sodium and chloride infusion along with urea will by itself produce acidosis. In addition to this, the absorption of chloride in excess of sodium with the demonstrated post-renal hydrogen ion gain further adds to a tendency to hyperchloræmic acidosis. Any potassium deficiency is not due to loss

of potassium by the ileum but must be secondary to dehydration and acidosis.

The tendency to imbalance produced by the use of ileum in the urinary tract should, on theoretical grounds, be combated by a high fluid and low salt intake and, if severe, by supplementary oral intakes of sodium and potassium citrate or carbonate.

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### RÉSUMÉ

Cette publication traite des changements que subit l'urine injectée dans une anse intestinale solée. Il a été trouvé que, dans ces conditions, le volume d'urine varie selon la densité spécifique; les urines de basse densité sont réabsorbées et celles de densité élevée sont diluées par des sécrétions de la muqueuse intestinale.

L'absorption du sodium et des chlorures varie selon les concentrations de ces électrolytes dans des urines de densité égale, mais cette règle n'est plus exacte lorsque les densités sont fortement modifiées. Par exemple, on voit que, pour des concentrations égales de sodium et de chlorure, les urines de densité élevée provoquent une diminution de l'absorption. L'iléon réabsorbe à n'importe quelle concentration toujours plus de chlorure que de sodium, et ceci indépendamment de la densité.

Le potassium et l'urée sont tous deux réabsorbés en proportion linéaire de leur concentration, et plus fortement dans les urines de faible densité. Les résultats présentés ici correspondent à ceux fournis par d'autres auteurs; il se fait à travers la muqueuse intestinale un mouvement de va-stvient des ions. Des phénomènes tout à fiit semblables se produisent au niveau du côlen, exception faite pour ce qui est du potassium.

La pathogénèse de l'acidose par hyperchlorém e, telle qu'elle apparaît dans les cas où un segment d'iléon est employé dans le tractus urinai e, ressemble tout à fait à celle des anastomo es urétéro-coliques. La déshydratation causée par l'hypertonie sodique et chlorique et également uréique donnera naissance à une acidose; de phis, l'hyperabsorption de chlorure par rapport au sodium va exagérer cette tendance à l'acidose. Une déficience en potassium n'est pas causée par une perte de potassium au niveau de l'iléon, muis est secondaire à la déshydratation et à l'acidose.

Lors de l'utilisation d'un segment d'iléon dans le tractus urinaire, le déséquilibre électrolytique ainsi provoqué doit être combattu par l'administration de grandes quantités de liquide pauvre en sel, et dans les cas graves, on donnera, oralement, du sodium et du potassium sous forme de citrate ou de carbonate.

# URETEROCELE IN ADULTS

From the Karolinska hospital in Stockholm, Sweden, comes a review of 25 cases of ureterocele in 18 adults (11 women and seven men). The authors, Aas and Nilson (Acta. Chir. Scandinav., 116: 263, 1959) have followed up this series for periods ranging between nine months and 18 years. In the initial cystoscopic examination two of the cysts were not discovered, and the diagnosis was made solely on urography. On the other hand, three ureteroceles were not detected on urography although demonstrated cystoscopically. Thirteen of the 18 ureteroceles not associated with stone were treated conservatively and the remaining five surgically by the transurethral route, three being electroresected or electrocoagulated. Seven ureteroceles containing stone were all treated operatively. After conservative treatment, follow up for two to 18 years showed no change in size of the ureteroceles or in ureteral drainage. In one case there was some vesico-ureteral reflux. In the group treated surgically but without stone, initial examination had shown that the section of the ureter involved by the ureterocele was obstructed. At follow up between two and 10 years later, the obstruction to drainage had wholly disappeared in two instances, and was appreciably less in two others. In the remaining case, a stone had been extracted from the pelvic segment of the ureter and the stricture dilated; the initial distension of the ureter had definitely diminished. In the group associated with stone, one recurrence was found but three of the four cases in which there had drainage.

It would seem that these cysts assume their final size, together with a definite degree of u eteral obstruction, early in their development and that the condition then remains stationary if no complication interferes.

An uncomplicated ureterocele which has 1 of caused obstruction at an early stage will not 30 so later. In surgically treated cases, there is 30 the whole no tendency to recurrence after elect oresection or coagulation. The uncomplicated c. se with a cyst no larger than a walnut and without decrease in kidney function should be left alo e.

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## HEPATOLOBECTOMIE DROITE

ROLAND CAUCHON, M.D., F.A.C.S., PAUL BROCHU, M.D. et LOUIS LEVASSEUR, M.D., F.R.C.S.[C], Québec, Qué.

O: PEUT AFFIRMER sans crainte d'erreur, que la chirurgie hépatique, même la chirurgie traumatique, a toujours été considérée conme très compliquée. L'hémorragie produite par n'importe quel traumatisme, chirurgical ou autre, sur un réservoir si considérable de sang, a toujours été la ra son principale de cette difficulté. En ef et, nous devons nécessairement compter sur le tamponnement de la plaie comme de mière ressource au contrôle de l'hémorra jie parce que les sutures plus ou moins pénétrantes dans le parenchyme hépatique sont souvent insuffisantes à la contrôler.

C'est la raison pour laquelle ce ne fut pas avant 1911 qu'un chirurgien put se lancer avec succès dans la première lobectomie droite chez l'humain. Auparavant, en 1892, Keen avait pu se rendre compte qu'une grande partie du foie pouvait être réséquée sans trop de danger, et depuis ce temps, Ponfick avait démontré la régénération du tissu hépatique suffisante à la survie de l'individu. Et alor:, il v eut un espace de temps de quarante ans avant qu'une hépatolobectomie droite soit de nouveau effectuée. Bien sûr, pendant cette période de très nombreux articles furent publiés sur l'ablation partielle d'un lobe et la résection complète du lobe gauche. Pendant cette période aussi, des études plus approfondies des fonctions hépatiques furent faites et de nouvelles méthodes de combattre les hémorragies furent établies.

On peut avancer, en re tant dans les limites de la vérité, que jusqu'au vingtième siècle, il y avait vraiment d'excellentes raisons pour que l'hépatectomie droite ne puisse être faite. Les chirurgiens expérimentés connaissaient les énormes difficultés qui les attendaient quand ils se lançaient dans une résection partielle et ils savaient aussi que, quand une tumeur maligne développée dans le foie est mise en évidence lors d'une laparotomie, il est déjà souvent trop tard pour se permettre une

résection étendue, parfois dangereuse et même mortelle.

Quant au cancer de la vésicule biliaire, il avait toujours été traité par la cholécystectomie seule, avec un taux effarant de récidives et de mortalité. Et ceci à un tel point qu'en 1924 Blalock disait: "Dans le cancer de la vésicule biliaire, quand un diagnostic positif peut être fait sans exploration chirurgicale, il est inutile d'opérer puisque cela a pour effet de raccourcir la survie du patient". Avec la notion nouvelle d'une régénération importante de tissu hépatique, avec la connaissance récemment acquise que 20% environ du foie est suffisant à la vie; et par dessus tout, avec la certitude que le développement de nouvelles cellules hépatiques dans un court espace de temps, va fournir un support suffisant à la partie du foie qui reste, les chirurgiens ont commencé il y a environ sept ans à croire à la résection du lobe droit du foie et depuis ce temps, nous avons pu lire dans la littérature mondiale plusieurs articles sur la procédure chirurgicale à suivre et sur les résultats obtenus. Quelques travaux ont même été publiés sur l'hépatolobectomie droite pour des lésions bénignes intéressant une partie étendue du lobe droit du foie, où les résultats ont été excellents. C'est ainsi que depuis les trois ou quatre dernières années, nous avons été fortement impressionnés par ces articles publiés sur les maladies du foie et de la vésicule biliaire et en sommes venus à certaines conclusions que nous allons maintenant exposer.

Nous savons que de 1 à 3% des vésicules biliaires enlevées au cours d'une opération présentent des signes positifs de malignité à l'examen histologique. Comme tant d'autres nous en sommes venus à cause de cet état, à nous faire l'opinion que toutes les vésicules biliaires malades doivent être enlevées si l'état général du patient le permet. Du point de vue prévention simple, c'est certainement le meilleur traitement actuel. Mais, quand une lésion maligne s'est établie, nous avons une situation bien différente.

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La lésion maligne n'est pas curable par des moyens ordinaires, et nous avons des preuves abondantes depuis cinquante ans que la récidive du cancer est immédiate, ou plutôt, que l'extension du processus malin dans le foie se continue malgré la cholécystectomie; une intervention chirurgicale étendue pourrait aider à contrôler cet état pathologique. Kirshbaum et Kozoll ont trouvé que sur 55 patients morts de cancer de la vésicule biliaire, 51 présentaient une extension directe dans le foie. Par ailleurs, Rokitansky et Willis ont montré que "des embolies se déposent dans les branches terminales portes d'un lobule, s'y développent et perforent éventuellement dans un rameau porte voisin, et ainsi le processus se renouvelle d'une façon perpétuelle jusqu'à ce que le lobe hépatique en entier soit pris par une pluie de métastase;".

Sommes-nous donc pour nous en tenir à la vieille controverse ou bien de faire une cholécystectomie et d'attendre les métastases post-opératoires et la mort, ou de ne faire rien en nous déclarant satisfaits de savoir que la chirurgie n'a pas sa place dans un tel cas? Après l'excellent article de Lortat-Jacob en 1952 nous avons bien saisi la signification de l'hépatectomie droite réglée et nous avons pu suivre ensuite dans la littérature les opinions divergentes sur ce nouveau procédé. Nous en sommes venus à la conclusion avec plusieurs auteurs, que si à l'opération on ne peut trouver de métastase, le patient est un sujet à soumettre à l'hépatolobectomie. Nous sommes aussi de l'avis de plusieurs, qu'une simple biopsie sur une tumeur hépatique est complètement hors d'ordre et que le lobe doit être enlevé même si la lecture histologique extemporanée a montré qu'il s'agissait d'une lésion bénigne. Une résection partielle d'une tumeur est en elle-même plus dangereuse qu'une ablation complète. "Si à l'exploration une tumeur hépatique est trouvée réséquable, on ne doit faire aucune fragmentation de cette tumeur, mais une résection complète". Une excellent film sur: "Les indications et la technique de l'hépatectomie droite" avec narration personnelle par le docteur John T. Reynolds de Chicago finit par provoquer chez nous l'état d'esprit qu'il fallait et nous décidâmes que le prochain patient souffrant d'une cancer de la vésicule biliaire subirait une hépatolobectomie droite si son état général le permettait.

Cette opportunité nous fut offerte au début de 1958. Voici la description du procédé chirurgical employé et les résult ts obtenus.

Il s'agit d'une femme de 54 ans atteinte d'un diabète pour lequel elle recevait 30 unités d'insuline protamine zinc quotidiennement. A son entrée à l'hôpital, le 6 mars 1958, la glycémie était normale et il n'y avait pas de glycosuie.

Elle était obèse et se plaignait depuis 15 ans à peu près, de troubles digestifs occasionnés surtout par certains excès alimentaires qui de temps à autre dépassaient largement le régime qu'elle devait suivre. Elle était alors saisie d'une douleur aiguë dans l'hypochondre droit, qui s'accompagnait de vomissements. En général il y avait sédation des symptômes dans l'espace de 12 heures mais au cours du dernier épisode qui se produisit le 26 février, les symptômes durèrent trois jours. Elle se mit donc à une diète sévère de lait, légumes et fruits, et elle perdit 10 lb. (4,5 kg.) de poids. Bien qu'elle se fut soumise de plein gré au traitement, elle garda de cette dernière crise un douleur dans l'hypochrondre droit, et ce fut la raison de son hospitalisation.

L'examen physique nous montra un point de Murphy positif avec un certain degré de contracture musculaire dans la région de l'hypochondre droit. Le 7 mars, une cholécystographie mit en évidence un gros calcul de cholestérol dans une vésicule biliaire qui pouvait malgré tout se vider assez bien. La formule sanguine était tout à fait normale. En face de cet état persistant et surtout à cause de la durée des symptômes, nous décidâmes de faire une cholécystectomie.

Après une attente de quelques jours pour p éparer la malade à cette intervention, une cholécystectomie par incision paramédiane droite ut pratiquée le 12 mars. Nous pûmes constater u cours de l'opération un épaississement et une coloration blanchâtre bien particulière du fond de la vésicule biliaire, contractée sur de nonbreux calculs. Cette apparence nous sugg ra immédiatement la probabilité de transformat on maligne d'un processus chronique, et une xploration fut faite dans le but de détermi er s'il y avait des ganglions palpables dans le pé licule hépatique ou en arrière du duodéni n. Cette recherche fut négative et il fut aussi econnu qu'il n'y avait aucun nodule métastatic le dans le foie. La cholécystectomie rétrograde ut

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donc faite et les suites post-opératoires n'offrirent aucune particularité sauf que nous dûmes contiruer l'administration d'insuline telle qu'avant l'opération.

L'examen pathologique de la pièce confirma notre impression qu'il s'agissait d'un adénocarci ome papillaire du fond de la vésicule et c'est à ce moment qu'il fut décidé de faire une hépatolobectomie droite. La malade fut complitement mise au courant de la situation; nous primes le soin de lui expliquer, ainsi qu'à son miri, les raisons formelles de l'opération proposée avec les chances d'une guérison définitive. Les sons pré-opératoires furent immédiatement institués. Le 27 mars, deux semaines après la clolécystectomie, le lobe droit du foie fut ré-équé et voici la procédure que nous avons su vie.

La patiente fut placée en position "intermédi ire entre le décubitus dorsal et le décubitus la éral gauche", le bras droit en extension audessus de la tête, le flanc gauche soulevé par le support rénal, cette position permettant une extériorisation plus facile du foie dans la plaie. Une incision thoraco-abdominale fut employée, la partie thoracique oblique dans le lit de la huitième côte, la partie abdominale étant l'incision paramédiane droite qui avait servi à la cholécystectomie; les cartilages costaux furent divisée entre les deux parties de l'incision. Le diaphragme fut complètement divisé en deux jusqu'à la veine cave.

En inclinant la table à droite, nous arrivons à avoir la patiente en position couchée sur le dos, légèrement arquée. Le foie pouvait ainsi être repoussé dans le thorax ce qui donnait un champ libre assez considérable au-dessus du pédicule hépatique. En inclinant la table sur la gauche, nous pouvions repousser le lobe droit vers la ligne médiane ou vers l'hypochondre gauche, à condition que les ligaments falciforme et coronaire soient sectionnés. Nous avons conservé l'impression que la dissection postérieure extrêmement difficile a pu être faite sous meilleure vision grâce à cette manœuvre.

Une fois l'incision faite, la malade placée sur le dos et le foie disloqué dans le thorax, la dissection du pédicule hépatique fut immédiatement commencée et les canaux hépatiques isolés avec soin. Un ruban ombilical ou un catgut fut alors placé autour du canal hépatique droit. L'artère hépatique avec ses branches droite, moyenne et gauche fut ensuite identifiée et complètement disséquée. Il faut se rappeler que dans 75% des cas environ il existe une artère moyenne. La branche droite fut aussi isolée sur un catgut ou un ruban.

La veine porte est située juste en-dessous et un peu à gauche du canal hépatique. C'est un tronc très large, qui doit être disséqué avec un soin extrême, et à ce stage de l'opération, la paroi antérieure seule de cette veine peut être libérée complètement des tissus voisins. La bifurcation de la veine porte est très haut située, presque dans le foie.

Avant de changer l'angle de dissection, un ruban fut placé autour de la veine cave inférieure, au-dessus des veines rénales comme mesure de sécurité en cas d'hémorragie soudaine pendant la dissection des veines sus-hépatiques. La patiente fut ensuite inclinée sur le côté gauche et les ligaments coronaires droits furent sectionnés de sorte que le lobe droit put être entièrement déplacé vers la gauche, laissant ainsi un espace d'accès plus facile à la veine cave et aux veines sus-hépatiques en arrière du foie.

A cet endroit il y a souvent une languette plus ou moins triangulaire formée de tissu hépatique qui s'enroule autour de la veine cave inférieure et qui cache complètement les veines sus-hépatiques. Celles-ci sont en général au nombre de trois, les veines sus-hépatiques droite, moyenne et gauche, et dans la plupart des cas, les veines moyenne et gauche s'unissent en un tronc commun juste avant de se jeter dans la veine cave. La veine hépatique droite draine le segment postérieur et la partie supérieure du segment antérieur du lobe droit. La veine sushépatique moyenne draine la partie inférieure du segment antérieur du lobe droit, et en plus la partie inférieure du segment moyen. La veine sus-hépatique gauche draine entièrement le lobe gauche et en plus la partie supérieure du segment moyen. C'est à ce moment qu'il faut faire une identification précise des tissus à sectionner. Ce sont des vaisseaux très larges presque enfouis dans le foie, et à cause de leur brièveté, la dissection en est rendue très difficile.

En faisant une traction délicate sur le lobe droit vers la gauche, la languette de tissu hépatique qui se trouve en avant des veines sus-hépatiques fut sectionnée, et la veine droite, isolée par une dissection prudente. Par la rotation du lobe droit, les veines sus-hépatiques moyenne et gauche furent identifiées, et une pince courbe put être placée en arrière de la veine droite. Des ligatures à la soie assez forte furent ensuite placées, d'abord sur les veines surnuméraires situées plus bas que la veine sus-hépatique droite, et celle-ci fut ligaturée la dernière et sectionnée. Une pince Kocher fut appliquée sur l'extrémité proximale de la veine presque dans la substance hépatique. Il n'y avait pas de place pour deux ligatures. Nous eûmes ensuite un accès plus facile à la partie postérieure de la veine porte et sa dissection fut commencée.

Retournant maintenant au pédicule hépatique par rotation de la patiente en position dorsale,

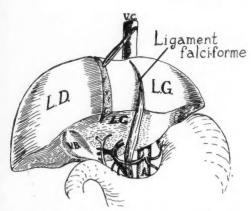


Fig. 1.—Division à l'instrument mousse, dans la plan anatomique du foie.

l'artère et le canal hépatiques droits furent sectionnés et ligaturés et nous eûmes ensuite une très bonne vision pour la dissection complète et définitive de la branche droite de la veine porte. Cette branche est très difficile à mettre en évidence et on doit la rechercher dans le foie même, tellement la bifurcation est haute et cachée dans le foie. Une ligature à la soie fut placée sur l'extrémité distale, une pince Kocher sur l'extrémité proximale et la veine sectionnée en!re les deux. Il ne resta plus qu'à faire la section du lobe droit du foie, et la section se fit en tenant compte de la circulation propre à chacun des lobes.

Nous savons que "la division anatomique en lobes droit et gauche ne se situe pas dans la ligne du ligament falciforme, mais va du bord

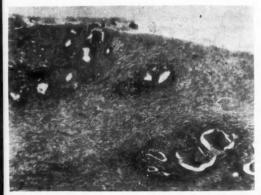
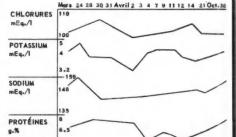


Fig. 2.—Envahissement du foie par un épithélioma canaliculaire à gauche. En haut, à droite, il persiste une plage du tissu hépatique atrophique.

gauche de la fosse vésiculaire jusqu'à l'orifice diaphragmatique de la veine cave inférieure. Ce plan est constant, et sépare les systèmes artériel, veineux et biliaire de chaque côte." Le lobe carré, de même que la moitié gauche lu lobe de Spigel font partie du côté gaucle. Ainsi la ligne de section doit s'étendre de la partie droite du lobe carré jusqu'au côté droit de l'ouverture diaphragmatique de la veine cave. Ceci représente donc une ligne de section oblique qu'il est préférable de faire à l'instrument mousse, par exemple le manche du bisto iri (Fig. 1).

Nous rencontrâmes chez notre malade ces branches parfois très grosses, artérielles, veineuses et biliaires que nous pûmes ligaturer avant de les sectionner. On ne peut dire que nous ayons été vraiment incommodés par l'hémorragie peropératoire. Nous couvrîmes la surface cruentée d'un fragment prélevé aux dépens du grand épiploon, et drainâmes la cavité abdominale avec un drain cigarette, la cavité pleurale avec un drain sous l'eau, et ensuite nous suturâmes la plaie thoracique et abdominale.



**ELECTROLYTES** 

Fig. 3.—Graphique du bilan électrolytique après l'intervention jusqu'au 30 octobre.

RÉSERVE ALCALINE (CO<sup>2</sup>) mEq./I

L'intervention dura sept heures. L'anesthé ie rachidienné continue fut employée, combinée au thiopental (Pentothal Sodium). Trois littes de sang, et en plus un litre de dextrose 1 % contenant 20 unités d'insuline furent administré pendant l'intervention. Deux heures avant la in de l'opération 40 unités d'ACTH furent injecté s. Ceci fut répété quotidiennement pour trois jou s.

Le pouls se maintint autour de 80 par mint te et subit très peu de variations. La tension ar érielle ne dépassa jamais 160/90 pendant l'opé ation. A la fin de l'opération les chiffres se lisaient comme au début, 140/80. Les urit es 1. 3

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étaient libres de sucre et d'acétone à la fin de l'opération.

e rapport anatomopathologique nous apprit qu : le lobe pesait 770 grammes et que ses dimensions étaient de 20 sur 14 sur 6 centimètres. Microscopiquement, l'épithélioma canaliculaire ay nt son point d'origine dans la vésicule biliaire en ahissait le foie autour du lit de la vésicule. Pa tout ailleurs le foie était normal (Fig. 2).

Au cours des premiers jours après l'opération, nous eûmes à combattre un état d'hyperglycémie s'é evant jusqu'à 342 mg. %. Il fallut continuer l'insuline jusqu'au 31 mars alors que la glycémie de int normale. Pendant les deux premiers jours du chloramphénicol (Chloromycetine) fut admi listré aux huit heures. Du sucre interverti à 105, d'un métabolisme plus facile pour le foie, de: protéines et des solutions électrolytiques genre Ringer, furent injectées quotidiennement à la patiente jusqu'à ce qu'elle devint en état de s'alimenter suffisamment. Il est de toute nécessité que ces patients reçoivent une diète hyperprotéinique pour au moins quelques jours, justement à cause de la fonction hépatique diminuée.

La diurèse quotidienne varia chez notre malade de 1500 à 2500 c.c. et nous primes soin de n'employer de narcotiques que le strict nécessaire. Nous n'eûmes aucun trouble métabolique, et nous croyons bien que ce résultat est en rapport avec une administration bien équilibrée de liquides et d'électrolytes. Pendant une journée ou deux, sur la jambe droite, à un endroit où nous avions fait une dissection veineuse pour l'injection peropératoire de solutés, nous avons craint le développement d'une thrombophlébite, mais cette crainte fut heureusement de courte durée. Durant quatre jours une légère coloration ictérique de la peau se manifesta, puis cette coloration disparut rapidement. Pendant deux ou trois semaines, une certaine quantité de bile s'écoula de la plaie, et ensuite l'écoulement devint séreux. Cependant, de temps en temps nous avons retrouvé de la bile sur le pansement et même maintenant, il existe un petit tractus fistuleux qui donne de temps à autre un petit peu d'écoulement. La température ne s'éleva jamais au-delà de 101° F. pour retourner à la normale dans un espace de huit jours. A la fin de la première semaine post-opératoire, nous permîmes à notre malade de se lever et de marcher dans sa chambre. Son appétit s'est amélioré graduellement et de temps en temps nous avons confirmé par des examens sanguins appropriés, que l'évolution post-opératoire a été réellement plus facile que nous l'avions prévue. Les tracés électrolytiques pris à différents intervalles, le premier, trois jours avant l'opération et le dernier, le 30 octobre, montrent l'évolution

relativement facile même dans les jours de plus grand stress (Fig. 3).

Les fractions potassium et protéines, à un moment donné, accusèrent une chute légère, mais celle-ci n'a jamais dépassé un seuil que nous avons pu ramener à la normale promptement.

Nous avons été très satisfaits de l'état postopératoire de notre malade. L'état graphique de son évolution forme la preuve la plus convainquante de la possibilité de cette opération et pour le patient et pour le chirurgien. L'hospitalisation s'est terminée le 12 mai. Après son retour à la maison, l'amélioration de la santé a été graduelle de sorte que trois mois après l'intervention chirurgicale, la patiente pouvait reprendre ses travaux domestiques habitueis.

### SOMMAIRE

Un cas d'adénocarcinome de la vésicule biliaire est présenté. Le traitement a consisté en une hépatolobectomie droite. La technique employée est ici décrite de même que les résultats post-opératoires immédiats et éloignés.

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#### SUMMARY

It is known that from 1 to 3% of gall-bladders removed at operation show positive signs of malignancy on histological examination. Moreover, such malignant lesions are not curable by simple cholecystectomy and only a more extensive surgical operation can do the patient any good. The present authors conclude that if a patient has a malignant lesion of the gall-bladder without obvious metastases, a right hepatolobectomy should be performed. They describe in detail such an operation upon a woman of 54 years with mild diabetes upon whom a retrograde cholecystectomy was performed

and a malignant lesion of the gall-bladder found. Two weeks after the cholecystectomy the right lob of the liver was resected by a technique describe in detail, the operation lasting seven hours under spinal ansesthesia combined with thiopentone. Histological study of the liver showed that epitheliom had indeed invaded the liver around the bed of the gall-bladder. Postoperatively, the patient require insulin for several days and a high protein diet. In mild jaundice was seen for several days and for several weeks afterwards bile emerged from the wound. In fact, a very small biliary fistula still persists, but the patient is now well enough to return to her work.

### CARCINOMA OF THE GALL-BLADDER

Two Stockholm surgeons, Arner and von Schreeb (Acta. Chir. Scandinav., 116: 477, 1959) discuss carcinoma of the gall-bladder, with particular reference to two of their own cases, one of carcinoma and one of chronic cholecystitis simulating cancer. They also review cases of gall-bladder carcinoma from two large Swedish hospitals. They note that the incidence of gall-bladder carcinoma is given as 0.87% of biliary tract operations, and that gall-stones have been found in as many as 94% of a series of such tumours. They agree that the prognosis of carcinoma of the gall-bladder is extremely poor and that patients rarely survive for five years.

Their series consisted of 49 cases of carcinoma of the gall-blader treated between 1940 and 1957. Cancer was found in 0.5% of all cases of cholecystectomy. No definite symptoms characteristic of carcinoma could be distinguished. Pain, jaundice, emaciation and various dyspeptic symptoms were noted, together with fever. On examination, tenderness in the gall-bladder region, jaundice, palpable tumour at the site of the gall-bladder and enlargement of the liver were some-

times noted. In only six out of 36 cases operated upon was a tentative preoperative diagnosis of carcinoma of the biliary tract made. Diagnosis was even difficult at laparotomy. In 20 out of the 36 cases, extensive malignant disease was already present with metastases, not amenable to radical removal. In seven cases a cholecystectomy was performed, and the diagnosis of cancer not made until the specimen had been examined histologically. In nine cases a tumour interpreted by the surgeon as gall-bladder carcinoma was found. In eight of these nine cases a cholecystectomy was performed and in one case this was supplemented with a wedge excision of adjacer t liver tissue.

No patient survived for more than 18 month, and the 13 patients not undergoing operation died within two months. The authors draw attention to the great difficulty of diagnosing cacinoma of the gall-bladder, but state that more extensive surgical procedures including wedge excision of adjacent liver tissue or even lobectomy may contribute to a more favourable prognosis. Early operation for gall-stones should be a prophylactic against cancer.

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### INTUSSUSCEPTION IN INFANTS AND CHILDREN\*

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INTUSSUSCEPTION is the commonest acute abdominal emergency in children under one year of age. It is the purpose of this paper to review 238 cases of intussusception proven by barium enema or laparotomy, seen at the Winnipeg Children's Hospital over a 14 year period (1943-1956).

### ETIOLOGY

In adults intussusception is usually caused by some mechanical abnormality, whereas in infants and children no cause can be found in the majority of cases. An organic cause was found in only 5.9% of our cases, as shown in Table I.

TABLE I.—Demonstrable Causes of Intussusception in 169 Operations

Cause	Cases	Percentage
Meckel's diverticulum	7	4.1%
Congenital duplication	2	1.2%
Polyps	1	0.6%
Total	10	5.9%

### SEX INCIDENCE

Males were more commonly affected than females. The percentages were males—61%; females—39%.

### AGE INCIDENCE

Seventy per cent (167 cases) occurred in the first year of life (Table II). The peak incidence was from the third to the seventh month (Fig. 1). The youngest patient was seven days old. In this patient, a congenital duplication at the ileocæcal valve was

TABLE II.—Age Distribution of 238 Cases of Intussusception

Years of life	Percentage of cases
Under 1 year	70%
1 - 2 years	. 16%
2 - 3 years	5.4%
Over 3 years	8.6%

found at operation to be the starting point of an intussusception.

### SEASONAL INCIDENCE

Thirty-two per cent of cases of intussusception occurred during the summer, as shown in Table III. This increased inci-

TABLE III.—Seasonal Incidence of Intussusception (238 Cases)

Season	Percentage of cases
Autumn	 23%
Winter	 20%
Spring	24%
Summer	32%

dence in the summer months might be explained by the frequency of gastroenteritis in this community during the summer. Increased peristalsis and changes in the bowel wall, with gastroenteritis, probably predispose to intussusception.

# SYMPTOMS AND SIGNS OF INTUSSUSCEPTION

The symptoms and clinical findings in our series are shown in Table IV. The symptoms of intussusception are usually alarming and the intense paroxysms of pain with vomiting should suggest the diagnosis. The presence of a sausage-like mass

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TABLE IV.—Signs and Symptoms of Intussusception (238 Cases)

1.	Rhythmical abdominal pain (screaming or drawing up of legs, periodic)	89%
2.	Associated pallor during pain	33%
	Vomiting	78%
4.	Blood in stool or on digital examination.	67%
5.	Abdominal mass (sausage-like along colon)	50%
	Temperature over 101 °F	13%
7.	Shock and dehydration	9%

Presented at the 1958 meeting of the Western Division of the Canadian Association of Clinical Surgeons, Winnipeg.

Associate Professor of Surgery, University of Manitoba; Surgeon, Winnipeg Children's Hospital; Chief of Department of General Surgery, Winnipeg General Hospital.

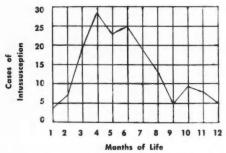


Fig. 1.—Age distribution of intussusception during first year of life.

along the colon and blood in the stool help to confirm the diagnosis.

### DURATION OF SYMPTOMS

The duration of symptoms in our 238 cases is shown in Table V. No deaths

TABLE V.—Duration of Symptoms in 238 Cases of Intussusception

Duration of symptoms	Percentage of cases
Under 12 hours	43%
12 - 24 hours	22%
24 - 36 hours	14%
36 - 48 hours	4%
48 - 60 hours	5%
Over 60 hours	12%

occurred in the 65% of cases in which symptoms had been present for less than 24 hours before admission.

Surprisingly, there were 12% of cases in which symptoms had been present for more than 60 hours, and some of these were successfully reduced by barium enema. Some of this group were really cases of chronic intussusception, in which there was no complete obstruction and the blood supply of the bowel had not been damaged.

### Types of Intussusception

The types of intussusception as recorded by the surgeons are shown in Table VI. It is our belief that almost all intussusceptions in children really start as ileo-ileal ones and go on to become ileo-ileo-colic. If the starting point is near the ileo-cæcal valve, the surgeon will often record the intussusception as ileo-colic.

TABLE VI.—Types of Intussusception Found in 169 Operations

Types of intussusception	Percentage of cases
Ileo-colic	75%
Ileo-ileo-colic	15%
Ileo-ileal	9%
Cæco-colic and colo-colic	1%

# USE OF THE BARIUM ENEMA IN

The barium enema is a useful diagnostic procedure in intussusception and in experhands will reduce the intussusception in a high proportion of cases. The experience of Scandinavian<sup>1, 2</sup> and Australian<sup>3-6</sup> authors and of Ravitch<sup>7-10</sup> has demonstrated that hydrostatic pressure with barium enema under fluoroscopic control is a safe and effective method of reducing intussusception.

TABLE VII.—Mortality Rates in Cases of Intussusception (1943-56)

Overall mortality rate in 238 cases	8 deaths— 3.3%
Surgical mortality rate (169 operations)	8 deaths— $4.7\%$
Resection mortality rate (22 resections)	4 deaths-18.1%

In the last 9 years there were 170 cases; 88 were reduced by barium enema and 82 required surgery; 18 resections were performed. There were no deaths in this nine year period.

The routine in this hospital when intussusception is suspected is an immediate consultation with a radiologist and a surgeon. A diagnostic barium enema is administered and if an intussusception is found an attempt is made at reduction. using hydrostatic pressure under fluoroscopic control. The technique of reduction by barium enema has been published elsewhere by Dr. Arthur Childe,11 our radiologist. If there is any doubt about complete reduction, that is, if the terminal ileum is not well filled by barium, the surgeon and operating room staff are available immediately. This eliminates delay if surgery becomes necessary. If the terminal ileum is not well filled with barium, operation is performed to avoid leaving an unreduced ileo-ileal intussusception.

Since 1949, when reduction by means of barium enema was first used here, 52% of all intussusceptions have been reduced

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successfully. In 12 cases where the radiologist was not satisfied that reduction was complete, laparotomy revealed that reduction had occurred either as a result of lydrostatic pressure or under the anæsthetic. There have been no deaths in cases where barium enema reduction was attempted.

### TREATMENT OF INTUSSUSCEPTION

The routine treatment in this hospital is an attempt at barium enema reduction. If this is successful (52% of all cases), operation is avoided. If it is unsuccessful or the terminal ileum is not filled, operation is carried out. In a few very ill patients, barium enema reduction may not be attempted.

Before operation a small catheter is placed in the stomach for gastric suction. Whenever shock or dehydration is present, intravenous fluids and/or blood transfusions are given.

The abdomen is opened by a split right rectus incision with the centre of the incision opposite the umbilicus. The head of the intussusception is milked back into the cæcum with the fingers in the abdomen; only when it is in the cæcum is an attempt made to deliver the mass out of the abdomen. It is then compressed with the hand and a warm sponge, and the intussusception is slowly extruded. Once it is reduced, the bowel is examined to determine viability. If the colour returns to the bowel wall and the mesenteric vessels pulsate or peristalsis appears in it after covering with saline packs, recovery will occur. If, however, the reduced bowel is obviously non-viable or the intussusception cannot be reduced, resection will be necessary. Occasionally, in a dangerously ill patient it is better to proceed at once with resection rather than attempt reduction. Gross12 emphasizes that in these critically ill patients reduction, if it is possible, may release "toxic" substances into the circulation which are sufficient to produce uncontrollable shock.

When resection must be performed, a decision must be made whether a primary resection or an exteriorization resection should be used. Where the surgeon is

inexperienced in intestinal problems in babies, the exteriorization operation will give better results. In extremely ill patients we have used the exteriorization resection.

### MIKULICZ EXTERIORIZATION RESECTION

This operation was used five times in our series with one death, a mortality rate of 20%. The intussuscepted mass or non-viable bowel is exteriorized and the wound closed around it. The two limbs may be sutured together to form a spur, before closing the abdomen, so that a crushing clamp can be applied later. A catheter can be sewn into the proximal bowel for drainage and the gangrenous loop cut away. If a spur has been formed it should be crushed in two to three days with a crushing clamp. It is usually possible to free the bowel stomata and restore continuity at a second operation in seven to ten days. This prevents too prolonged a period of loss of intestinal juices.

### PRIMARY ANASTOMOSIS

The majority of our resections were primary anastomoses. Seventeen cases were treated by this method with three deaths, a mortality rate of 17.6%. The majority of these were performed by end-to-end suture. A few cases had side-to-side anastomoses. In several, an aseptic end-to-end anastomosis with only one layer of silk sero-muscular sutures was used.

Barnes<sup>13</sup> in 1947 revived the old Jessett<sup>14</sup> intracæcal resection for irreducible intussusception. We have used this intracæcal, extraperitoneal resection in a modified form in four cases of irreducible intussusception. The technique of this operation is illustrated in Fig. 2. When the abdomen is opened and an irreducible intussusception is found in the cæcum and right colon, the following steps are carried out:

1. The intussusceptum (ileum) is sutured to the intussuscipiens (cæcum) by interrupted sero-muscular silk sutures.

2. The peritoneum is closed except for a small 5 cm. opening. The edges of this opening are sutured to the cæcum by a continuous suture in such a way that a bare area of cæcum is now extraperitoneal.

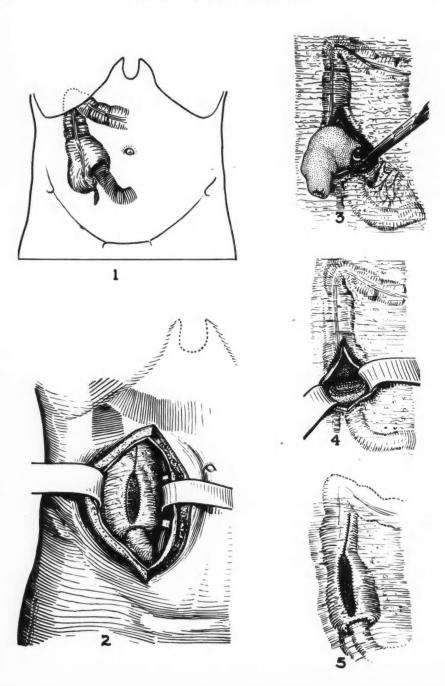


Fig. 2.

From this point on, the operation is extraperitoneal.

3. The wall of the cæcum is incised along he anterior tænia and the intussusceptum delivered from within it.

4. The amputation of the intussuscepted leum is then started by cutting partially icross the base of the intussusception inside he cæcum, and an Allis forceps is placed

on the double wall of ileum.

5. The double wall of ileum is then sutured with a continuous lock stitch of ntestinal chromic catgut and the remainder of the intussusception is cut off as this suture is placed. This completes the anasomosis.

6. The anterior cæcal wall is then closed n two layers.

7. The abdominal wall is then closed

n lavers with a Penrose drain.

Barnes used a catheter which was threaded through the ileal anastomosis and brought out through the anterior cæcal wall for decompression of the ileum.

The advantages of the intracæcal, extra-

peritoneal operation are:

- 1. The operation can be performed rapidly.
- 2. There is very little shock, since the resection is performed extraperitoneally.
- 3. There is no contamination of the peritoneal cavity and peritonitis does not occur.
- Only the destroyed bowel is removed. The healthy right colon is not sacrificed as it would be in any other form of resection.

# MORTALITY RATE IN CASES OF Intussusception (1943-1956)

The mortality rate in 238 cases of intussusception in the 14 year period (1943-1956) was 3.3% (eight deaths). The surgical mortality rate in 169 operations was 4.7% (eight deaths). The resection mortality rate was 18.1%-four deaths out of 22 resections.

All deaths occurred before 1948. Since 1948, 170 cases of intussusception have been treated. Eighty-eight of these were reduced by barium enema. Eighty-two cases were operated on and 18 resections were performed without a death.

The improvement in the last nine years is due not only to improvements in surgical technique, but also to the use of antibiotics and a better understanding of electrolyte and fluid balance in these small patients.

### SUMMARY

An analysis of 238 cases of intussusception proven by operation or barium enema in a 14 year period (1943-1956) is presented.

Barium enema reduction in expert hands is a safe procedure and was successful in

52% of cases since 1949.

A safe, rapid, extraperitoneal, intracæcal method of resecting an irreducible intussusception is described. This method preserves the right colon, which is sacrificed in any other method of resection.

Since 1948, 170 cases of intussusception have been treated without a death; 88 were reduced by barium enema, 82 required operation and 18 resections were performed.

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### RÉSUMÉ

Au cours d'une série de 238 cas d'invagination vus à l'hôpital de Winnipeg de 1943 à 1956 une cause organique ne fut trouvée que dans une cause organique ne fut trouver que dans une proportion de 5.9%. Les garçons formaient la grande majorité des cas (61%); 70% des patients étaient dans leur première année de vie. La fréquence maximale de cette affection se rencontre entre l'âge de trois et sept mois. Bien que certains auteurs prétendent que la plus grande fréquence chronologique se situe au mois de décembre, c'est pendant l'été que l'on vit 32% des cas de cette présente série.

La symptomatologie de l'invagination comprend des paroxysmes de douleurs abdominales, accompagnés de vomissements, des selles sanglantes et une masse en boudin le long du côlon. L'intervention précoce est essentielle; on n'eut à déplorer aucune mortalité chez les malades admis da s les 24 premières heures qui suivirent le début des symptômes (65% de cette série).

Les auteurs sont d'avis que la plupart des invaginations commencent dans l'iléon et se propagent ensuite au côlon. Le lavement baryté en plus d'être une épreuve diagnostique appréciabe possède aussi une valeur thérapeutique dont en contratte de la c s'est servi avec succès dans 52% des cas.

Lorsque l'intervention chirurgicale s'impose a petit malade est préparé par la mise en place d'u 1 tube de succion gastrique et d'une perfusion intraveineuse pouvant servir au déchocage, si néce saire. Le grand droit est divisé à droite à a hauteur de l'ombilique, l'invagination est réduite et d'après l'état de l'intestin, l'opérateur décice s'il doit passer à la résection ou refermer. Che le cuiet très maldes il vaut mieur pages s'exles sujets très malades il vaut mieux ne pas s'exposer à disséminer certaines toxines dans l'orga-nisme en cherchant à réduire la lésion; mieux vaut la réséquer d'emblée par intervention intra-abdominale ou par extériorisation-résection. La technique des deux méthodes est brièvement exposée nique des deux methodes est brievement expose dans le texte ainsi que celle de la résection intra-cæcale extra-péritonéale employée dans les cas irréductibles. L'analyse des chiffres de mortalité montre que depuis 1948, 170 cas ont été traités sans aucune perte de vie.

## ORGANS PALPABLE IN THE NORMAL ABDOMEN

Because they felt that the authorities on clinical examination did not clearly state which organs were palpable in the normal abdomen, Bearn and Pilkington of London, England (Lancet, 2: 212, 1959) examined 100 male medical students and 100 female student nurses, with ages ranging between 18 and 24, to determine which structures could normally be felt and how often. In addition 15 subjects were x-rayed to investigate the relation of the palpating hands to the lower pole of the kidney.

The stomach, pylorus, duodenum and small intestine were not identified in any of the men or women; the cæcum was felt as a soft illdefined mass in the right iliac fossa of all but 15 men and 11 women. Only on one occasion was the transverse colon palpated. In 88 men and 90 women the descending colon was felt as a firm sausage-shaped structure in the left iliac fossa. The liver was felt in only 11 women and two men; the anterior border was identified as a soft ill-defined edge. The two men with a palpable liver were both exceptionally lean. The spleen was felt at the end of deep inspiration in two women (these however gave a history of recent febrile illness which could have been mononucleosis). The left kidney was not felt in any subject, nor the right kidney in any man but the latter was felt in 11 women, who were all conscious of something being grasped in the right loin while the kidney was being identified. The aorta was palpable in most women but only in about half the men. In some very lean suljects it could even be grasped between finge's and thumb.

The authors think that the abdominal aorta was felt more readily in women because of the resistance offered by the rectus abdominis in men. There was less difference between the sexes as regards resistance of abdominal muscles in the iliac fossæ.

# DESCRIPTION D'UNE NOUVELLE TECHNIQUE CHIRURGICALE DE SUSPENSION ARTIFICIELLE DES ORGANES INTRA-PELVIENS°

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L'IDÉE PREMIÈRE de ce travail vient du traitement du prolapsus rectal. Les deux affections présentent une analogie frappante et nous avons consacré une étude assez étendue au problème du prolapsus des organes intra-pelviens en général, afin de déterminer la possibilité d'appliquer au prolapsus vagino-utérin le traitement employé dans le prolapsus rectal.

Le prolapsus rectal complet a toujours posé un problème très embarrassant comme le démontre clairement le grand nombre d'opérations différentes qui ont été utilisées dans le traitement de cet état. Bien que l'affection fut elle-même connue depuis longtemps, et la nature des lésions pathologiques décrite avec assez de précision, il demeurait que, sans connaître le mécanisme de sa production, impliquant à la fois le jeu des facteurs anatomiques et physiologiques, il était impossible d'apporter à sa thérapeutique une compréhension uniforme, une interprétation adéquate ou une cure définitive. Les échecs dont s'accompagnent la plupart des opérations proposées traduisent la remarquable incompréhension dont s'entoure encore la thérapeutique du prolapsus rectal. Dans une restauration rationnelle de la conformation anatomique et de la fonction physiologique, il faut reconnaître l'importance du soutien actif de l'organe et le rôle de l'angulation normale du coude ano-rectal, dont le mécanisme procure une protection naturelle contre le prolapsus quand le rectum est soumis à de fortes pressions.

Il en est de mème, quoiqu'à un degré moindre, du prolapsus vagino-utérin, dont l'étude ici est venue se greffer à celle du prolapsus rectal. Gynécologues et chirurgiens ont pendant longtemps cherché à mettre au point une méthode satisfaisante de traitement, dont le principe pourrait ètre

universellement appliqué à la correction de tout prolapsus génital et parer indifféremment à toutes ses éventualités. Cependant, malgré les nombreux procédés médicaux et chirurgicaux qu'on a suggérés, la plupart des méthodes de traitement se sont montrées moins satisfaisantes qu'elles auguraient au moment de leur description, même si la proportion d'échecs fut moindre que pour le prolapsus rectal. La même incompréhension du mécanisme physio-pathologique de production du prolapsus vaginoutérin a conduit aux mêmes échecs observés dans le cas du prolapsus rectal. Le traitement chirurgical doit viser, par un procédé simple et anatomiquement correct, à remettre à leur place normale l'utérus et le vagin prolabés, de façon à procurer à la patiente une amélioration définitive et permanente de ses symptômes et de son infirmité.

Une telle opération implique d'abord le respect des rapports anatomiques des organes concernés, et particulièrement de la vessie (cystocèle) et du rectum (rectocèle) souvent affectés par le prolapsus, L'opération doit de plus assurer ou restituer à l'organe la fonction normale de son état physiologique actuel surtout pendant la période active de la vie génitale, en n'entravant ni le coït, ni la fertilité, ni l'évolution normale de la gestation ou de la parturition. Si certaines de ces exigences n'existent pas après la ménopause, il est par contre nécessaire, chez les patientes d'un certain âge et parfois débiles, de limiter au minimum l'étendue et le traumatisme de l'intervention, de façon à ménager le plus possible un état général déficient.

C'est en considération de ce double facteur anatomique et physiologique qu'il nous semble justifié d'étendre et d'appliquer au traitement du prolapsus vagino-utérin la technique opératoire originale primitivement conçue pour la correction du prolapsus rectal. Il ne semble en effet faire aucun doute que, dans la restauration de la protection naturelle offerte aux organes intra-pelviens par leurs propres moyens de

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Service de Chirurgie, Hôtel-Dieu de Québec, et Départment d'Anatomie, Université Laval, Québec. Travail subventionné par le Conseil National des Recherches du Canada.

fixation (assurés d'abord par le soutien actif de leur suspension et, secondairement, par le support passif du plancher pelvi-périnéal), l'apport de mesures qui soient à la fois anatomiques et physiologiques puisse vraisemblablement représenter une amélioration considérable sinon définitive vers une cure chirurgicale permanente.

L'intervention ici proposée pour réaliser ce but consiste à suspendre l'organe prolabé à la symphyse pubienne par l'intermédiaire d'une bandelette pédiculée provenant de l'aponévrose du muscle grand droit.

# Présentation de la Technique

# (1) Bases et Description (a) Bases

L'expérience du prolapsus rectal a montré que, autant l'objet de son traitement peut sembler versatile, autant son échec peut s'avérer constant, et que si celui-là est très incertain, celui-ci est assez assuré, Une pareille situation résulte évidemment de l'incompréhension même du mécanisme fondamental de production du prolapsus, dont la pathogénèse présuppose une connaissance parfaite des moyens de soutien de l'organe, et surtout de leur importance respective. La seule considération des lésions pathologiques évidentes se révèle totalement insuffisante à assurer une interprétation juste de l'influence relative des éléments de support. Elle conduit infailliblement, comme le démontrent les principes impliqués dans les méthodes de traitement préconisées, à considérer comme causes du prolapsus les effets imputables à son développement.

Une telle erreur est d'autant plus grave qu'elle empêche la reconnaissance du rôle ligamentaire actif de fixation dans le soutien rectal; elle le subordonne en réalité au rôle purement passif du support périnéal. Imputer ainsi la cause du prolapsus à la laxité du sphincter et des muscles releveurs traduit, par la confusion de la cause et l'effet, l'incompréhension du processus pathologique intime du prolapsus. On ne doit pas attribuer au plancher pelvien plus qu'un rôle absolument passif dans le support des organes intra-pelviens, car leur fixité est assurée par leurs propres moyens de

suspension exactement au même titre qu'est réalisé l'équilibre spatial ou la sustentation de la plupart des viscères de l'organisme.

La nécessité, voire la possibilité, de reconnaître au diaphragme pelvien un rôle décisif dans la prévention du prolapsus ne s'est jamais imposée à notre considération au cours de la discussion des différents facteurs impliqués dans sa pathogénie. Nous avons cependant décrit une certaine action freinatrice, lui prêtant ainsi une fonction accessoire, qui, sans présider ou prendre part à la genèse même du prolapsus, se montrera susceptible, suivant le cas, ou de ralentir son développement, ou de retarder son éventualité, ou de diminuer ses complications, ou enfin d'atténuer l'étendue et la sévérité des perturbations anatomiques secondaires qui peuvent en résulter. Pareille conception se trouve vérifiée par l'expérience chirurgicale du prolapsus et surtout par l'évolution du comportement postopératoire qui permettent de constater, dès la correction de l'anomalie et la prévention de sa récidive, une récupération simultanée de la tonicité des tissus et des muscles rendus flasques, atones et relâchés par la présence même du prolapsus.

Nous affirmons donc que les lésions musculaires du plancher pelvien, bien qu'adjuvantes, résultent du prolapsus luimême et sont intimement dépendantes de son évolution, représentant en quelque sorte son accompagnement ou encore son complément nécessaire. En conséquence, il nous apparaît raisonnable et justifié de soutenir ici que les causes importantes dans la production du prolapsus rectal sont l'anomalie du revêtement péritonéal, responsable des vices de conformation et de position de l'organe, l'insuffisance de ses moyens de soutien, encore appelés support actif du rectum, enfin la perturbation de la fonction du muscle releveur de l'anus, qui, par sa contraction, permet normalement d'accertuer l'angle ano-rectal.

De la discussion de ces considérations pathogéniques et étiologiques, ressort le principe même de la technique que nous nous proposons maintenant de décrire et de mettre à l'épreuve. Sa conception est orientée vers la restauration à la fois de la conformation anatomique et de la fonction physiologique. L'élément anatomique, pet t

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être révélé après réduction du prolapsus, par la triple observation de l'ouverture maintenue élargie de l'anus par traction sur ses marges; de la prévention de descente du prolapsus (malgré les efforts du patient pour le recréer) par simple pression digitale sur le périnée antérieur, mais non postérieur; de la perception au toucher ectal de la chute première de la paroi ectale antérieure au moment de l'effort.

Quant au facteur physiologique, qu'il suffise de rappeler qu'il se rapporte surtout u mécanisme de support que procurent, chez l'individu normal au moment de la léfécation, les modifications de l'angulation mo-rectale (modifications de la position lu rectum à l'égard du canal anal), et sans lequel nous serious tous vraisemblablement sujets au prolapsus rectal. Or comme dans tous les cas graves de prolapsus rectal, il est cliniquement évident que ce mécanisme fait défaut, nous avons pensé corriger le mécanisme releveur et offrir un support efficace au rectum en l'immobilisant antérieurement au moyen d'une greffe pédiculée, à insertion pubienne, provenant de l'aponévrose du grand droit.

L'idée d'utiliser une bandelette d'aponévrose dans la réparation de diverses défectuosités anatomiques n'est pas nouvelle et son application a été adaptée à une foule d'indications de chirurgie reconstructive, parfois très disparates, mais le plus souvent suivie de résultats heureux et fort satisfaisants, qu'il aurait été même impossible dans certaines circonstances d'atteindre autrement. Les avantages de la greffe aponévrotique sont évidents: d'une part, elle survit presque inchangée et, d'autre part, agissant comme un véritable tendon aplati, elle peut être utilisée pour la création artificielle d'un ligament suspenseur. A ce sujet, la permanence de sa fonction est confirmée par l'examen histologique qui révèle que, plusieurs mois après fixation, la bandelette aponévrotique est toujours constituée d'une masse de fibres parallèles divisées en faisceaux par de fines trames de tissu conjonctif vasculaire. La manipulation de la greffe aponévrotique, enfin, est d'une technique relativement simple et peu compliquée.

# (b) Description

Dans la conception même de toute thérapeutique rationnelle du prolapsus, on doit réaliser ce double élément essentiel qui comporte, avec une compréhension absolue du mécanisme physio-pathologique de sa production (surtout la prééminence du rôle des vices de conformation du support actif de l'organe), une considération adéquate des facteurs impliqués, physiologiques aussi bien qu'anatomiques. Or, basée sur de tels principes et assurant, d'autre part, cette double restauration anatomique et physiologique recherchée, la technique proposée ici, ne serait-ce que pour ces seules raisons, nous apparaît marquer un progrès véritable dans le traitement du prolapsus rectal. L'opération elle-même, en outre, est de technique simple, de réalisation facile, d'exécution rapide et, fait important, d'application universelle, comme en fait preuve la description générale qui suit.

Sous anesthésie générale, rachidienne ou épidurale, le champ opératoire est disposé selon l'installation habituelle à la chirurgie pelvienne. Après ouverture de la paroi abdominale par une incision para-médiane droite sous-ombilicale, mise en place d'une valve sus-pubienne, luxation de la table en position de Trendelenburg, et isolement du petit bassin, le premier temps capital de l'intervention est le dégagement de l'ampoule rectale dans sa portion sous-péritonéale. Même si le cul-de-sac de Douglas est profond, ce qui est fréquent mais non constant, on s'aperçoit que c'est seulement la traction sur le rectum sous-péritonéal libéré qui permet la mise en tension nécessaire à une suspension efficace. L'expérience a d'ailleurs montré que le segment sous-péritonéal du rectum est généralement très lâche, mobile et ample, et de plus que cette portion du rectum située au-dessous de la réflexion péritonéale apparait toujours plus considérable qu'on pourrait normalement s'y attendre.

La libération de l'ampoule doit se faire dans la gaine (et non pas au large comme en vue de l'exérèse pour néoplasie) afin de ne pas léser les nerfs à destinée génito-vésicale. La section péritonéale suit la ligne de réflexion rectale de la séreuse à partir de la terminaison du méso-sigmoïde en regard du promontoire. En arrière, le clivage se fait dans l'espace rétrorectal en respectant le pédicule hémorroïdal supérieur; vers le bas, il faut rester au contact du viscère et ne pas effondrer la lame nerveuse qui l'atteint; la dissection doit cependant tendre

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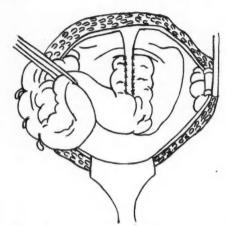


Fig. 1.—Fixation de la bandelette à la paroi antérieure du rectum.

à exposer la jonction du rectum avec le muscle releveur, de façon à donner à l'organe l'opportunité de former de nouvelles adhérences. En avant, la dissection est facile mais doit se prolonger, selon le cas, au-dessous du niveau de la prostate ou très bas sur la paroi vaginale postérieure. Sur les côtés, il est parfois nécessaire de sectionner la partie haute de l'aileron latéral, ce qui doit se faire au contact de l'ampoule et non vers la paroi pelvienne.

A la fin de ce premier temps, le repère constitué par la ligne péritonéale sur la face antérieure de l'ampoule permet de mesurer l'ascension obtenue (cette ligne est facilement amenée au promontoire ou très peu au-dessous). C'est dans cette position que l'ampoule rectale doit être maintenue par la fixation, en corrigeant la laxité inutile mais en évitant par contre toute tension.

Dans le second temps, de suspension, il faut, sur la ligne médiane, commencer par la mise en place de l'extrémité inférieure, fixe, de la bandelette aponévrotique provenant du grand droit, sur la paroi antérieure de l'ampoule rectale. La suture doit appliquer la bandelette bien étalée en largeur et solidarisée au rectum sur quatre à cinq centimètres de hauteur. Pour ce faire, il faut sur chaque bord de la bandelette, à partir de l'angle inférieur, placer cinq ou six points de fil non-résorbable qui prennent d'autre part solidement la musculeuse rectale (Fig. 1). Au total, cette mise en place de la bandelette n'offre guère de difficulté.

Le dernier temps est la péritonisation. En reconstituant la couverture péritonéale devant l'ampoule rectale (mais en arrière de la bandelette), on prend soin de ne reformer aucun cul-de-sac pré-rectal, associant ainsi à la rectepexie une suppression du cul-de-sac de Dougla:

# (2) Expérimentation

# (a) Méthodes expérimentales

Quiconque dissertant sur le prolapsus d'i rectum serait d'abord porté à croire qu'un telle anomalie, chez l'homme, est l'apanage de sa station verticale; or il n'en est rier, puisque une revue de la pathologie animale y révèle l'existence d'un tel état, dont la description d'ailleurs embrasse exactement les manifestation cliniques observées chez l'homme.

Une étude expérimentale du prolapsus est justifiée du fait qu'il existe normalement et constamment, au moment de la défécation, une certaine tendance de la muqueuse intestinale à prolaber. C'est d'ailleurs la persistance d'un tel phénomène une fois l'évacuation intestinale terminée, qui, tant chez l'animal que chez l'homme, constitue la condition même de prolapsus. L'anatomie topographique du contenu pelvien, chez le chien où l'affection peut exister spontanément, se prête bien à l'étude du problème de la thérapeutique du prolapsus, en la rendant directement applicable à l'homme.

Quant à l'évaluation même de la technique, la preuve en a été cherchée suivant différents procédés dont la nature sera donnée avec la description du travail expérimental. Le devenir de la bandelette a été régulièrement vérifié in situ, au cours d'une nouvelle intervention chirurgicale. On a étudié les modifications structurales qu'y avait déterminées son implantation, l'évaluation de sa résistance, l'assurance de sa stabilité et la permanence de son nouveau rôle de soutien. Un examen attentif de ces caractères purement morphologiques, après son prélèvement, fut complété par une analyse histologique minutieuse et approfondie par un pathologiste compétent. La bandelette a toujours été prélevée de la même façon, par section de son extrémité distale au niveau de son insertion pubienne et excision du segment pariétal où elle était fixée: ainsi recouvrée dans ses dimensions primitives, elle ne pouvait mieux s: prêter à une étude topographique complète, permettant des sections à la fois longitudinales et transversales. L'examen histologique de chaque bandelette a toujours porte

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sur plu ieurs sections colorées non seulement à l'hématoxyline-éosine, mais souvent aussi avec des colorants spéciaux pour fibres élastiques.

Les tendances évolutives locales de la bandelette, la réalité et la permanence de sa nouvelle fonction en dépit des nombreuses conditions défavorables auxquelles les protocoles expérimentaux l'ont soumise, représentent les critères mêmes qui ont servi à juger la valeur de la technique proposée, comme à expliquer le succès des résultats obtenus et, partant, à assurer son efficacité évidente dans la cure du proapsus.

## (b) Réalisations expérimentales

Une étude expérimentale de tout proansus peut supposer trois voies d'approche différentes au problème: elle peut porter sur un prolapsus déjà existant, créer un état de prolapsus, ou enfin ignorer le prolapsus pour s'efforcer plutôt de mettre à l'épreuve la solution proposée à son traitement. Or si le choix du procédé d'étude peut à première vue paraître assez libéral, il faut cependant admettre que les deux premières possibilités sont ou inutilisables ou de réalisation difficile. Notre travail s'est donc astreint à faire la preuve de la technique proposée, en insistant d'une façon particulière sur son efficacité réelle et la discussion des avantages qui ressortent de son emploi.

Pour atteindre ce but, nous avons imaginé trois expériences, ou plutôt trois groupes d'expériences, dont un premier, exécuté chez des animaux mâles, permettrait de vérifier l'efficacité du rôle de la suspension décrite, et les deux derniers, effectués chez des animaux femelles, apprécieraient, d'une part, la valeur de cette suspension et, d'autre part, confirmeraient à coup sûr le rôle et la valeur de la technique proposée.

Expérience 1: Efficacité du rôle de la suspension aponévrotique artificielle du rectum.

### Protocole expérimental

Les animaux furent ici répartis en deux groupes représentant respectivement un groupe témoin de trois animaux et un groupe expérimental de douze animaux. Chez les trois chiens témoins, deux furent témoins absolus, non-opérés mais soumis aux seuls traitements constipant ou cathartique ultérieurement décrits, l'autre fut un témoin chirurgical, opéré et soumis exactement à la même intervention que les animaux mis en expérience, sauf évidemment pour la suspension du rectum.

Les animaux du groupe expérimental furent sub-divisés en trois sous-groupes de quatre chiens chacun, auxquels on administra dans les suites opératoires immédiates et éloignées, soit une diète normale, soit un régime constipant ou cathartique. La constipation était produite par adjonction à la diète normale de sels de bismuth utilisés à la dose quotidienne d'un gramme, alors que la diarrhée était provoquée par l'addition de cathartiques soit salin (en l'occurrence du sulfate de magnésie à la dose quotidienne de 15 g.), soit huileux (huile de ricin servie à la dose quotidienne de 15 c.c.), utilisés alternativement. L'un et l'autre de ces états était d'ailleurs aggravé, ou du moins son induction facilitée, par l'administration intra-musculaire, pour les cinq premiers jours suivant l'opération, de substances agissant directement sur la musculature intestinale, paralysant sa motilité (sulfate d'atropine) ou la stimulant (méthylsulfate de néostigmine), et utilisées suivant les doses suggérées par Ivy et ses collaborateurs.1, 2

# Résultats et Conclusions Evolution générale

Les suites opératoires, tant immédiates qu'éloignées, ont toujours été normales, banales mème, et la convalescence, rapide, progressive et sans incidents. L'étude attentive de ses différents facteurs constituants ne permet aucune comparaison préjudiciable entre l'évolution des animaux expérimentaux et celle des témoins, tant identiques sont les conditions des deux groupes.

### Epreuves fonctionnelles

L'évolution satisfaisante de l'état général n'implique pas l'absence complète de perturbations fonctionnelles locales, de même qu'on ne peut non plus à la seule observa-

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tion des animaux exclure la possibilité d'atteinte à la physiologie normale des fonctions organiques. Il semblait donc nécessaire de s'assurer que la bandelette ne pouvait en aucune façon modifier ou perturber le fonctionnement normal des appareils urinaire ou digestif, surtout dans leur fonction vésicale et rectale, que la bandelette pouvait le plus directement gèner par sa simple présence.

Or la mesure du volume urinaire, après blocage urétral, a révélé d'une part que la réplétion vésicale pouvait s'effectuer normalement, sans contrainte apparente, et d'autre part que la capacité vésicale ellemème était demeurée inaltérée. Cette constatation a pu être vérifiée au cours d'une réintervention ultérieure pour étudier localement l'état de la bandelette. La conservation intégrale de la fonction vésicale s'explique par le mécanisme de sa réplétion, la distension de l'organe s'opérant latéralement, par véritable expansion centrifuge surtout de ses bords latéraux.

La fonction rectale, fut appréciée par l'observation de la défécation, l'examen des matières fécales et surtout le toucher rectal qui, par la constante stabilité du rectum, apportait une confirmation indéniable à la solidité du support assuré par la bandelette d'aponévrose. Le toucher rectal permettait de reconnaître l'intégrité des contours intérieurs normaux du rectum, rétablis ou laissés inchangés lors de l'opération, et témoignant d'une fonction rectale physiologiquement normale, que venait confirmer la coexistence d'un fonctionnement harmonieux des autres actes digestifs (appétit, courbe pondérale, etc).

Ces différents procédés d'investigation furent enfin complétés, au moment de la réintervention, par un examen endoscopique du rectum. L'étude rectoscopique permet une vue directe de l'angle ano-rectal et en général, de la position mème du rectum et des effets de la suspension aponévrotique. Dans tous les cas, les modifications apportées par la bandelette se sont montrées entièrement conformes à une réalisation normale des fonctions physiologiques concernées, n'intervenant en aucune façon dans les divers mécanismes impliqués, comme l'avait d'ailleurs suggéré la simple

étude du comportement général de ; animaux.

# Constatations anatomiques

La preuve décisive du rôle de la bandelette devait cependant être recherchée o i plutôt confirmée au cours d'une nouvelle intervention, après laparotomie exploratrice et examen in situ de la topographie pérnéale. Il nous est apparu de première impoitance d'éliminer l'influence possible du facteur temps, ou mieux, de soumettre la technique à l'épreuve du temps. Il semblait aussi convenir de connaître le sort de la bandelette, l'évolution de son comportement histologique et le caractère de ses transformations morphologiques éventuelles. Pareille procédure aurait l'avantage semblait-il, sinon de faciliter l'interprétation des résultat obtenus, du moins de confirmer et de renforcer l'appréciation du rôle de la bandelette et, en même temps, d'éliminer en partie les critiques dont la technique pourrait être l'objet.

Pour satisfaire à la fois à toutes ces exigences, les constatations anatomiques furent recherchées de façon indentique dans tous les groupes, d'après le procédé exposé plus haut. Le protocole opératoire lui-même est demeuré inchangé tel qu'antérieurement décrit.

A l'examen du lieu opératoire, il convient d'abord de reconnaître l'intégrité des rapports anatomiques et l'apparence normale de la topographie pelvienne, à savoir, la conservation des caractères morphologiques normaux de chaque organe.

Il en est de même de l'apparence extérieure de la bandelette, dont les caractères morphologiques n'ont accusé, dans leur ensemble, aucune modification évidente. Avec le temps, cependant, il devient de plus en plus difficile de reconnaître le segmei t rectal du greffon, son identification ne relevant souvent que de la présence des points de suture. Il semble en effet que la présence de la bandelette sur la paroi rectale déclenche une réaction cellulaire local? bien définie, et la formation d'une couche celluleuse diaphane qui enveloppe conplètement cette portion de la bandelette. Son identification devient alors difficile, et même aussi parfois celle des points de soi?

roire, cachés par une transparence souvent imparfaite.

Les dimensions de la bandelette à son prélèvement sont les mêmes que celles enregistrées à sa fixation. L'identité des chiffres élimine donc tout doute sur le sort nième de la bandelette. Elle exclue toute possibilité d'altération qu'aurait pu subir la conformation première du greffon et qui, sous forme de rétraction, d'élongation ou e core de dégénérescence, aurait pu affecter l'état du lambeau aponévrotique ou de perturber son rôle de suspension artificielle a tive et efficace.

Enfin, les examens histologiques à differents intervalles montrent qu'à l'un ou l'utre des stades étudiés, la bandelette a ponévrotique présente toujours les caracteres propres et spécifiques d'un véritable tendon, consistant en une longue bande de fibres parallèles séparées en faisceaux, ou mieux, cloisonnées par de fines trames de tissu conjonctif vasculaire. La stabilité de ses caractères morphologiques peut donc en partie corroborer la stabilité de son nouveau rôle anatomique de soutien. Son efficacité persiste malgré la fréquence d'exercices physiques post-opératoires violents et la nocuité de régimes alimentaires entraînant ou un état de constipation ou un état de diarrhée (d'une influence déclenchante reconnue dans le prolapsus rectal). Sa constance est assurée par l'immutabilité de ses résultats en dépit des conditions défavorables imposées comme épreuve à la technique.

Expérience 2: Appréciation de la valeur de la suspension aponévrotique artificielle du rectum.

# Protocole expérimental

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Les animaux furent répartis ici en deux groupes: cinq animaux témoins et huit animaux d'expérience. Le groupe témoin comprenait: deux témoins absolus, nonopérés mais soumis à l'un ou l'autre des régimes constipant ou cathartique; un seul témoin du stress chirurgical (par suite du peu de répercussion de l'acte opératoire), opéré et soumis exactement à la même intervention que les animaux mis en expérience, exception fait évidemment du temps de la suspension rectale, et enfin des

témoins expérimentaux, chez qui une seule bandelette aponévrotique disposée soit longitudinalement, soit circulairement fut utilisée dans la suspension du rectum.

Les animaux du groupe expérimental furent sub-divisés en quatre sous-groupes de deux chiennes chacun d'après l'agencement des deux bandelettes aponévrotiques. Cet agencement fut convergent, parallèle, divergent ou circulaire selon les sous-groupes. Chacun des animaux de ces divers groupes reçut soit un traitement constipant, soit un traitement cathartique, administré de la même façon qu'au cours de l'expérience précédente.<sup>3</sup>

# Résultats et conclusions Comportement général et épreuves fonctionnelles

L'évolution des animaux du groupe expérimental, de même que les épreuves fonctionnelles répétées après l'intervention, n'a montré aucune altération de l'état général.

# Constatations anatomiques

D'après l'examen des organes in situ, malgré le stress continu imposé à la fonction rectale, il est impossible de conclure à l'avantage d'un procédé sur l'autre. Au point de vue microscopique, aucun agencement structural de la bandelette ne peut donc être considéré supérieur à un autre et, en pratique, la méthode la plus simple devient la meilleure.

L'application des techniques histologiques utilisées antérieurement dans l'étude du devenir de la structure intime de la bandelette confirme totalement les résultats obtenus, avec cette réserve évidente que les réactions de la séreuse péritonéale y apparaissent généralement plus importantes.

Dans la suspension artificielle du rectum par des bandelettes aponévrotiques prélevées du grand droit, le nombre de bandelettes fixées à la paroi rectale antérieure, leur nombre ou leur agencement ne contribuent en rien à leur fonction première; en conséquence, ils ne peuvent évidemment modifier la valeur de l'intervention. Il reste toutefois que deux de ces types de conformation, soit les bandelettes parallèles et les circulaires, sont cependant suscep-

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tibles, par suite de leur disposition particulière, de déterminer de sérieuses complications d'ordre mécanique, sous forme d'obstruction ou d'une nouvelle invagination intestinale.

Ces constatations entraînent nécessairement le rejet ou du moins la modification des opérations fondées sur un principe semblable, soit en particulier la fixation de bandes parallèles et médianes suivant la technique de Orr,<sup>6</sup> ou encore la confection d'un manchon aponévrotique récemment décrite par Nigro.<sup>5</sup>

Bien que la critique des opérations jusqu'ici proposées ne relève pas de ce travail, rappelons cependant que la totalité des techniques de plastie reconstructive utilisant des bandes aponévrotiques comme ligaments suspenseurs du rectum, n'ont jamais recouru qu'à des segments dévitalisés d'aponévrose, constituant de la sorte beaucoup plus une transplantation d'aponévrose qu'une véritable greffe tissulaire. La technique que nous proposons ici, sans aucun doute préférable, permet l'utilisation d'une greffe aponévrotique pédiculée par le maintien de ses attaches pubiennes, qui assurent ainsi au nouveau ligament une conservation de ses caractères structuraux primitifs, dont dépend en partie d'ailleurs l'opportunité de son rôle.

Le muscle grand droit participe à l'effort de défécation par sa contraction et la bandelette, en vertu de son insertion pubienne, dépend de la terminaison tendineuse du muscle qu'elle recouvre. En accentuant ainsi l'angulation du coude anorectal, elle peut améliorer la position du rectum dans l'évacuation intestinale et restituer à ce mécanisme sa physiologie normale.

C'est la première fois qu'est utilisée dans la suspension artificielle du rectum une bandelette de l'aponévrose du grand droit, malgré son accès facile et immédiat qui aurtait dû la faire préférer à tous les autres artifices utilisés avec plus ou moins de succès. Ses caractères structuraux stables, vérifiés par des études histologiques répétées, la désignent parfaitement pour son nouveau rôle de ligament suspenseur.

Expérience 3: Confirmation du rôle et de la valeur de la suspension aponévrotique artificielle des organes intra-pelviens.

Des expériences antérieures avaier: établi le rôle et l'efficacité de la suspension aponévrotique artificielle du rectum³ et démontré la valeur même de l'élément suspenseur.⁴ La qualité et la constance de résultats obtenus, ainsi que les conclusions irréfutables qui en découlent, auraient offert assez de preuves comme nous le verrons au cours de l'analyse et de la discussion de ces expériences, pour justifier la transposition immédiate de l'intervention chez l'homme et préconiser son application clinique courrante.

Ils nous est cependant apparu préférable, avant de lancer définitivement la technique pour utilisation générale, d'apporter une confirmation ultime à l'opportunité qu'elle représente dans le traitement du prolapsus rectal. La fixation de la bandelette aponévrotique à l'utérus d'un chien femelle, éventuellement soumis aux variations structurales et trophiques de la gestation et de la parturition, nous a semblé un procédé physiologique bien indiqué pour éprouver le rôle et la valeur de cette suspension artificielle. L'utilisation de cette méthode personnelle et originale, permettrait une étude directe de la répercussion, sur l'état de la bandelette, d'une perturbation importante des rapports topographiques locaux, ou même tout simplement du stress mécanique inhérent à l'évolution des processus physiologiques mentionnés plus haut. Elle offrirait donc un témoignage suprême à la stabilité, à la résistance et à la permanence de la fixité obtenue.

La réalisation de l'expérience, par le principe de la technique qu'elle veut éprouver, pouvait permettre un jour d'appliquer le procédé à l'étude spécifique du prolapsus utérin. Une étude approfondie du prolapsus des organes intra-pelvient, comportant à la fois l'étude des prolapsus rectal et utérin, loin d'être incompatible, s'avérerait peut-être souhaitable, voir éclectique en vue de la contiguïté des organes en cause, de l'analogie du mécanisme de production de leurs affections, de l'identité en principe de leur thérapeutique, et enfin de la contingence de leur coexistence.

### Protocole expérimental

Les animaux furent répartis en trois groupes: un groupe témoin de trois animaux et un groupe expérimental de dix. Celui-là, réduit à trois animaux, comprenait in témoin absolu, non-opéré et deux témoins chirurgicaux qui, opérés et exposés a i stress chirurgical de la même intervent on que les animaux du groupe expérimental, exception faite évidemment du temps de la fixation viscérale de la bandelette, ont également reçu l'un ou l'autre des regimes constipant ou cathartique. Une de ces deux chiennes fut fécondée, comme ténoin de l'état de gestation.

Les animaux du groupe expérimental furent divisés en deux sous-groupes de c nq chiennes chacun. L'unique distinction entre les deux venait du nombre et du lieu de fixation de la bandelette: unique et rattachée à l'utérus dans un groupe, double et fixée à la fois à l'utérus et au rectum dans l'autre. Des cinq animaux de chaque sous-groupe, un fut conservé intact et les quatre autres furent rendus gravides et soumis, de plus, à l'un ou l'autre des régimes constipant ou cathartique déjà décrits.

La gestation fut facilitée par provocation artificielle de l'ovulation suivant une technique très efficace, recommandée par un vétérinaire de nos amis (une injection quotidienne, pendant trois jours, d'une forte quantité de stilbœstrol). Quant à l'étude de la bandelette, elle fut faite à intervalles réguliers, soit après 60 et 70 jours du début présumé de la gestation. Cette période correspond en réalité à la fin de la gestation et des suites de couches (soit en moyenne cinq, jours avant et après la parturition).

# Résultats et conclusions Etat général

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L'état général des animaux n'a montré aucune altération et les observations relevées au cours des premières expériences sont demeurées les mêmes après l'intervention.

# Epreuves fonctionnelles

La répétition des épreuves fonctionnelles appliquées antérieurement révèle, abstrac-

tion faite des modifications gravidiques, que la présence de la bandelette ne peut en aucune façon perturber le fonctionnement normal des appareils urinaire, digestif ou génital, principalement dans leur fonction vésicale, rectale ou gravidique respective. Ces constations s'appliquent aussi bien à la double bandelette rectale et utérine qu'à la bandelette utérine unique.

Les différentes épreuves prouvent que la gestation et la parturition ne sont pas incompatibles avec la présence de la bandelette.

# Constatations anatomiques

L'examen des organes in situ varie énormément des modifications structurales de la grossesse, à la topographie relativement normale des suites de couches (phénomène d'involution post-gravidique); cependant les caractères propres de la bandelette s'affirment immuables, comme d'ailleurs se révèlent constants les liens ou les rapports qu'elle établit. Force est donc d'admettre l'efficacité d'un mécanisme de suspension, capable d'assurer à la fois l'immobilisation rectale et la fixité utérine en dépit des perturbations locales importantes qu'y déterminent l'état gravidique et le processus d'involution qui le suit.

La bandelette a été soumise au cours de cette expérience à l'épreuve relativement pénible d'assumer en l'absence des ligaments larges (particulièrement développés chez le chien) la suspension et la stabilité d'un utérus gravide. L'évolution normale de la grossesse et de la parturition, malgré sa présence, représente un avantage extrèmement précieux. Le cours normal de cette fonction s'explique par la fixation relativement basse de la bandelette, qui ne semble entraver en aucune façon le développement de l'utérus. La bandelette conserve toujours ses caractères propres à type tendineux et ne participe pas ellemême aux modifications tissulaires gravidiques qui atteignent la paroi sous-jacente.

L'examen microscopique permet de vérifier le soutien du rectum et de l'utérus. Celui-là est soumis à l'agression morphologique que représentent les pression et les tiraillements dus à l'utérus gravide, et à l'agression fonctionnelle qui provient du péristaltisme de la diarrhée ou de la constipation. Celui-ci doit subir les modifications structurales trophiques et topographiques de la grossesse suivies des traumatismes et des lacérations de la parturition ainsi que des séquelles de viciation de l'involution post-gravidique. La réalisation de la fonction physiologique normale des organes intrapelviens met en jeu la stabilité de la bandelette dans son rôle suspenseur, Enfin l'étude histologique de la bandelette confirme les données précédentes sur son comportement général et corrobore les assertions antérieures relatives à la stabilité de ses caractères et à la permanence des rapports qu'elle établit.

La méthode d'évaluation appliquée à la suspension aponévrotique artificielle du rectum convient également à l'étude du prolapsus vagino-utérin, de sorte que les données expérimentales de cette communication s'étendent en général à tous les prolapsus pelviens.

La stabilité et le soutien des viscères pelviens dépendent fondamentalement d'une fixation ligamentaire active tels les replis péritonéaux, les ligaments suspenseurs et les attaches fibreuses viscérales, pour le rectum, et les ligaments larges et utéro-sacrés, pour l'utérus. Aussi longtemps que ces structures anatomiques conservent leur tonicité et leur force, l'ampoule rectale et le col utérin maintiennent leur position normale dans le bassin. La fixation ligamentaire active est complétée par un support périnéal passif, de sorte que si la genèse du prolapsus ne relève que d'une insuffisance (congénitale ou acquise) des movens de fixation, une incompétence du plancher pelvien peut augmenter secondairement la présence du prolapsus.

Il s'ensuit donc que la technique que nous préconisons ici, après épreuves confirmées de son efficacité et après comparaisons impartiales avec les différents procédés déjà existants, constitue une méthode thérapeutique avantageuse dont l'application peut être étendue au prolapsus de tout organe intra-pelvien.

# (3) Confrontation clinique

Les résultats, tels qu'espérés, sont excellents, tant du point de vue morphologique que fonctionnel. Utilisée à quatre reprises dans le prolapsus rectal complet et à deux reprises dans le prolapsus du dôme vaginal après hystérectomie, l'intervention n'a donné lieu, de façon immédiate ou éloignée, à aucune complication et n'a été suivie d'aucune récidive; bien que su re point notre série n'autorise pas de conclusion définitive, il n'en reste pas moirs que nos six cas, par le recul du temps de quatre à douze ans, ne sont pas néglegables.

Dans le cas du prolapsus rectal, on observe habituellement une récupération rapide du tonus des releveurs de l'anus, bien qu'aucune tentative n'ait été faite dans le cours de l'opération pour suturer ces muscles, et quoi qu'en pensent beaucoup d'auteurs. Considérant, d'autre part, le piètre état antérieur du sphincter anal, qui a été forcé, étiré, élargi, il est également surprenant de constater le retour rapide de la continence fécale. Or si cette recouvrance résulte d'un facteur mécanique puisque l'élargissement progressif de l'hiatus n'existe plus, il faut admettre qu'elle traduit également un rapide regain de la tonicité musculaire, montrant bien ainsi que la rectopexie sans l'aide du soutien périnéal, suffit à la contention.

Sans prétendre qu'elle doive être nécessairement substituée à toute thérapeutique déjà existante du prolapsus génital, il faut cependant reconnaître à la technique ici décrite certaines indications qui, parfois fort problématiques, seront particulièrement susceptibles de profiter de son emploi. Parmi ces dernières, mentionnons surtout le replacement d'un utérus destiné à des grossesses ultérieures ou encore la réparation d'un effondrement vaginal après hystérectomie.

Dans le premier cas, le procédé peut être avantageusement substitué à tot te variante des techniques de ligamentope ie ou d'hystéropexie abdominale dans chacu le des indications où ces opérations prévale it, dont surtout, selon l'opinion générale, la rétroversion utérine. La création d'un ligament pubo-cervical apporte ici un élément nouveau, ajouté au support actif de l'organe qui, élevant le col et rejetant l'utérus en avant, devient ainsi garant du maintien

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de l'antéversion utérine. Appliquée à la cure du prolapsus vaginal secondaire à l'hystérectomie, le résultat fonctionnel en re qui concerne la reprise des rapports exuels ne fait que confirmer la supériorité de l'opération. Tout en assurant un support efficace et sûr qui conserve à l'organe son orientation normale, et en réduisant la prolondeur des culs-de-sac péri-vaginaux par une excision péritonéale qui prévient toute possibilité d'entérocèle subséquente, l'intervention permet de plus le traitement adéquat de tout état pathologique associé, comme un moignon cervical suspect ou inlecté ou des ulcérations extensives à l'extrémité de la cavité vaginale. Dans le même sens, le procédé apparaît tout indiqué dans les grandes cystocèles, isolées ou prépondélantes, qui ne peuvent être adéquatement traitées par une simple périnéorraphie.

Enfin dans son application clinique, qu'il suffise de laisser entrevoir ici, comme particularités non-négligeables attachées à la technique, son absolue indépendance de la sévérité du prolapsus, de l'âge, de l'état général ou marital de la patiente, qu'elle satisfait adéquatement en permettant la conservation d'un vagin de longueur, de largeur et d'ampleur suffisantes à la réalisation du coît normal.

Il nous semble encore justifié en vertu même des conclusions expérimentales de ce travail, d'appliquer le présent procédé, dans ce qui peut représenter peut-être son couronnement technique, à la correction du double prolapsus recto-génital, réunissant ainsi dans une opération fort simple et à protocole unique les avantages spécifiques obtenus dans le traitement isolé de l'une et l'autre de ces anomalies.

### RÉSUMÉ ET CONCLUSIONS

Grâce à une compréhension éclairée du mécanisme physio-pathologique de sa production, une technique originale, simple et rationnelle, est mise au point qui se propose de corriger le prolapsus des organes intra-pelviens en restaurant à la fois leur conformation anatomique et leur fonction physiologique.

Attribuant le soutien des organes intrapelviens à une suspension ligamentaire active complétée d'un support périnéal passif, il s'ensuit que la formation primitive du prolapsus ne peut dépendre que d'une insuffisance de ses moyens de fixation, alors que son développement subséquent peut être facilité par l'incompétence du plancher pelvien. Ce rôle toujours secondaire du plancher pelvien n'intervient comme cause ou effet, que dans la progression du prolapsus, L'explication du prolapsus réside donc dans la faiblesse primitive des tissus de soutien, souvent congénitale, mais généralement acquise et résultant de phénomènes mécaniques locaux auxquels s'associent presque toujours des troubles trophiques.

Appliquées aux organes en cause, ces considerations pathogéniques traduisent la primauté d'influence, d'une part, du revètement et des replis péritonéaux, ainsi que des attaches fibreuses, osseuses et viscérales, pour le rectum, et d'autre part, des ligaments larges et utéro-sacrés pour l'utérus. Une incompétence (primitive ou secondaire) du plancher pelvien peut aussi contribuer à aggraver le processus.

La technique décrite se propose de redonner à l'organe prolabé sa position anatomique normale de la façon la plus physiologique possible, en se basant précisément sur l'importance du rôle des éléments actifs qui doivent assurer la fixité d'un organe. Pour atteindre ce but, elle recourt à une bandelette prélevée à même l'aponévrose du muscle grand droit de l'abdomen (le tissu aponévrotique représentant, à notre avis, le tissu idéal à employer sur une surface séreuse), qu'elle transfixe ensuite à la façon d'une greffe pédiculée sur la face antérieure de l'organe dont il faut prévenir le prolapsus.

L'efficacité du rôle de la technique a été maintes fois corroborée et sa valeur judicieusement éprouvée et confirmée. Spécifiquement conçue à l'origine pour la cure du prolapsus rectal et uniquement orientée vers elle, son application peut cependant être étendue, sans modification ni restriction, à tout prolapsus intra-pelvien. Enfin, sa réalisation simple et bénigne ne connaît aucune contre-indication et constitue, surtout en matière de prolapsus, un avantage thérapeutique hautement apprécié.

Cette technique originale de suspension artificielle des organes intra-pelviens, promet d'offrir au chirurgien une nouvelle arme simple et sûre dans le traitement du prolapsus de l'un ou l'autre de ces organes. Nous avons cherché dans cette technique à réaliser le vœu émis au sujet du prolapsus rectal par l'un des plus grands spécialistes actuels en la matière:

"Rectal prolapse is a humiliating complaint, whether to the parents of the infant sufferer, generally a boy, or to the aged, generally a lady, whose closing days are rendered dirty and degraded by this condition. It is hard to think of a complaint more calculated to bring one's gray hairs with sorrow and relief to the grave. The adult sufferers generally retire from all contacts with the outer world and live the life of social outcasts, and the opportunity for the surgeon to help them is heaven-sent, provided a good method of treatment is employed." (A. D. Wright, Proc. Roy. Soc. Med., 42: 1005, 1949.)

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### SUMMARY

Although the problem of pelvic organ prolapel has attracted the surgeon's ingenuity for sever I hundred years, little progress had been made in is understanding and its treatment until the last \$ 1 years.

After a brief review of the etiological facto's leading to this abnormality, the authors present a new surgical procedure which is proposed as a general method of treatment for pelvic organ prolapse, by fixing the organ to the symphys's pubis with a pediculate graft from the rectus fascia.

Based on the principle that the true etiology of prolapse consists primarily of an anatomical or physiological defect in the active support of the protruded organ rather than a mere alteration in the opening through the pelvic floor which actually follows the lesion, the operation is directed towards complete restoration of the anatomy and physiology of the organ.

The principal steps of the procedure are as follows: the abdomen is opened through a paramedian incision; the fascial strip is dissected from the anterior rectus sheath, saving its pubic insertion; the organ is freed by perivisceral incision of the peritoneum and the infra-peritoneal segment is mobilized by dividing the perivisceral fibrous bands; ascension of the organ into the abdomen is facilitated by slight traction at the point chosen for grafting; the fascial strip is fixed to the anterior wall of the organ (rectal ampulla, uterine cervix, vaginal stump) under light tension; the pelvic floor is reconstructed by closure of the perivisceral peritoneum. Finally, the abdominal wall is closed in the usual manner.

Consideration is particularly given to three points: (1) The repair is primarily designed to correct an anatomical defect in the active support of pelvic organs and consequently is based on their adherence to a neighbouring rigid structure, in this case, the symphysis pubis; (2) the fixation so obtained gives the organ a natural protection when submitted to its highest tension; (3) the technique has been fully tested both experimentally and clinically and has been found to be of very great value, especially in the treatment of rectal prolapse, uterovaginal prolapse in women desirous of having children, and genital prolapse after hysterectomy.

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## TRAUMATIC DISLOCATION OF THE HIP: A FOLLOW-UP STUDY°

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DAMAGE TO WEIGHT-BEARING joints all too frequently leads to severe disability, and injury to the largest of these joints, the hip, can be the most disabling of all. Traumatic dislocation and fracture-dislocation of the lip joint, rare a few years ago, now occur with increasing frequency in accidents of heavy industry and transportation. In order to determine the correct treatment and establish useful prognostic criteria, a series of cases at Vancouver hospitals has been analyzed as to the severity of injury, the ge of the patient, the interval between injury and reduction, and the period of non-weight-bearing after reduction. These cases were confined to anterior and posterior traumatic dislocations and fracturedislocations of the hip joint, the so-called central dislocations being excluded. The incidence of early and late complications will also be discussed.

The files of 62 patients were examined from the records of the Vancouver General Hospital (from 1936 to 1956 inclusive), from Shaughnessy Military Hospital (1946 to 1956) and from a few private consultations. Criteria for accepting cases were the availability of initial radiographs (or reports of these) and the possibility of at least a two year follow-up examination.

By correlating initial information on 62 cases with follow-up information on 48 of these, some conclusions can be drawn with respect to prognosis. Unfortunately, one important question—How long should we immobilize and restrict weight-bearing?—must remain as yet unanswered until a large, clinically controlled series can be accumulated.

# REVIEW OF LITERATURE

Recent years have seen several large follow-up series published. Armstrong<sup>1</sup>

followed up 100 dislocations for two to five years and found that 76% of simple dislocations and 63% of dislocations with fractures of the acetabular rim recovered fully, while only 40% of dislocations with head and neck fractures and none with acetabular floor fractures recovered completely. Paus<sup>7</sup> followed up 69 of 76 dislocations for three years or more and found that 9% had symptoms, 11% had signs, 26% had radiological signs and 28% had signs, symptoms and radiological signs.

Two larger series also showed that the more severe injuries give poorer results. Thompson and Epstein<sup>10</sup> who followed up 116 of 204 cases for from three months to 19 years stated that results in 67% of simple dislocations were good or excellent while only 15% of dislocations associated with fractures were in this category. Stewart and Milford<sup>8</sup> presented similar figures on the basis of 128 cases followed up for more than one year. Results in 66% of simple dislocations were good or excellent, while results in 35% with fracture were good or excellent.

The late complications - avascular necrosis, traumatic arthritis and myositis ossificans-are generally considered to be responsible for the poor results. Table I presents the figures of several authors for these complications. Avascular necrosis occurred in from 1.7% to 23.3% or an average of 14.2% in 646 cases followed up. Stewart and Milfords found this change in 40% of 28 open reductions. Traumatic arthritis was found in from 20% to 52.1% or an average of 41.9% in 502 cases followed up. Again, Stewart and Milfords found that 71.4% of cases treated by open reduction developed this late change. Myositis ossificans proved to be a rare finding, the usual figure being 1 to 2%, though Paus<sup>7</sup> apparently found nine cases in 60 dislocations followed up. It was very common, however, in Stewart and Milford's8 series of 28 open cases and the finding of periarticular calcification was also common.

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TABLE I -- COMPLICATIONS\*

Author	No. of cases	Sciatic nerve lesions	Avascular necrosis	Traumatic arthritis	Myositis $ossificans$	Recurrence	
Ghormley and Sullivan Stewart and Milford	73 193	24 (33.0%) 17 (13.3%)	10 (13.7%) Closed: 14 (15.5%)	38 (52.1%) 44 (48.8%)	2 ( 2.7%) 2 ( 2.2%)	1 (1.4%	
Thompson and			Open: 11 (40.0%)	20 (71.4%)	28 (100%)	_	
Epstein	204 144	26 (12.7%)	$27 (23.3\%) \\ 14 (9.8\%)$	37 (31.9%)	2 ( 1.7%)		
Armstrong	100	7 ( 7.0%)	$\begin{array}{c} 2 & (2.0\%) \\ 1 & (1.7\%) \end{array}$	26 (26.0%) 12 (20.0%)	1 ( 1.0%) 9 (15.0%)	1 (1.7%	
Urist	42	4 (14.3%)	2 (7.1%)	12 (42.9%)	(/0/	1-11/6	

\*Percentage figures are not necessarily based on the total number of cases but rather on the number of observations made or the number of cases followed.

The incidence of sciatic nerve palsy is also of interest (Table I). These figures range from 7% to 33%, though Ghormley and Sullivan<sup>4</sup> state that their high figure undoubtedly represents a selected series. Excluding this high figure, the average incidence in 539 dislocated hips is 11.8%.

A fourth late complication which is rarely mentioned is recurrent dislocation of the hip. Ghormley and Sullivan<sup>4</sup> mention one in 73; Paus<sup>7</sup> reports one in 61; Sullivan and his colleagues<sup>9</sup> report a single case and were able to find seven cases in the literature up to 1945.

### ANALYSIS OF INITIAL INJURY

There were 62 traumatic hip dislocations available for this analysis. Fifty-two of these were in males and 10 in females, a ratio of 5:1, which is slightly higher than in other reported series.<sup>2, 3, 9</sup> Age ranged from three and one-half to 77 years with a peak incidence in the third decade; 62% occurred in the 20 to 50 year age group. There were 39 right hips and 23 left hips involved. No case of bilateral dislocation occurred in this series.

Thirty-eight of the 62 dislocations occurred in motor accidents, 10 were the result of industrial accidents, seven were

TABLE II.—DEGREE OF INJURY

Type I	21 cases
Type III	19 "
Type IV	4 "
Type V	11 "
Unknown	3 "

caused by falls from a height and seven resulted from miscellaneous stresses such as skiing, fighting, sleigh-riding and trip-

With regard to degree of injury, cases were classified according to Stewart and Milfords as Type I dislocation (with no or insignificant fracture); Type II, with acetabular rim fracture; Type III, with comminution of the acetabular rim; Type IV, with fracture of the femoral head or neck; Type V, with fracture of the acetabular floor; and a combined type. Because of the difficulty of distinguishing by x-ray the single large acetabular rim fragment from the comminuted acetabular rim, Types II and III were grouped as one. The distribution of cases with reference to degree of injury is shown in Table II.

The interval between injury and reduction was determined in 55 cases. Approximately half of these were reduced within 12 hours of injury but there remained 27 in which reduction was delayed from 12 hours to over four weeks.

TABLE III.—PERIOD OF NON-WEIGHT-BEARING

10 - 14 days					,								5	cases
2 - 4 weeks.													6	66
4 - 6 weeks.													9	44
6 weeks to 3 m	on	tł	ıs	į									18	66
Over 3 months													8	6.6
Unknown													16	66
													-	
													62	cas

Information on the period of restricted weight-bearing and type of immobilization was difficult to obtain. The non-weighbearing period was, however, fairly well recorded (Table III). The greater frequency of the six weeks to three mont's

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period of non-weight-bearing is the result o a group being immobilized in plaster o traction for six weeks and allowed an a lditional one week in bed to mobilize. p us another group with additional injuries requiring longer periods in bed.

Sciatic nerve lesions were recorded in 1) of 62 cases but unfortunately the condition of this nerve was not mentioned in 32 instances. The probable incidence of nerve damage of 16% in this series falls within the range of 7% to 33% (average 1.8%) given in other reports. 1, 4, 7, 9, 12 Tiree of these lesions were in Type I dislegations and consisted only of temporary st bjective paræsthesias. In the remaining seven there were objective findings; all these were dislocations associated with fracture of the acetabular rim. None was explored.

# ANALYSIS OF FOLLOW-UP INFORMATION

Final information is available in 48 of the 62 cases. Three were followed up for one and a half to two years; the remainder were followed up for two to 11 years. There were six deaths, four of which occurred within two weeks of injury and were due to multiple injuries; two were from other disease, one and five years after dislocation.

Criteria for determining the end result in the remaining 42 cases were both clinical and radiological, though in four instances questionnaires provided the only final information available. In evaluating the outcome of traumatic dislocation of the hip joint it is apparent that, when reconstruction of the joint by open operation becomes necessary, the result of treatment of the dislocation can be considered a failure. In this report, failures are those cases requiring arthrodesis or arthroplasty. Poor results were associated with major complaints of pain, disability or change of employment, a major degree of deformity or restriction of movement and major radiological changes, chiefly of osteoarthritis or avascular necrosis. For an excellent result, an absolute absence of complaints, clinical findings and x-ray changes was required. Results were judged fair or good if they fell in the range between poor and excellent.

TABLE IV.—OVERALL RESULTS

Failure.	,			×									4		12~(29%)	
Poor						è									5 11 (26%	7)
Fair															6) 11 (20)	0.1
Good	*					×	×							,	12) 19 (459	
Exceller	ıt				×										7) 19 (45%	0)

Overall results are shown in Table IV. There were 12 failures, a rate of 29%. These included three arthroplasties performed within two weeks of injury. Of the results 26% were fair or poor, 45% good or excellent.

TABLE V.—RESULTS BASED ON DEGREE OF INJURY

	Failures	Poor	Fair	Good	Excellent
Type I Type II	2	0	1	5	5
and III.	2	3	2	5	1
Type IV	3	0	1	0	0
Type V	0	2	0	0	1
Combined	4	1	1	1	0

Results are considered on the basis of degree of injury in Table V. Of 13 Type I dislocations, results in 10 were good or excellent, a success rate of 77%. The two failures occurring in this group of presumably less severe injury were due to avascular necrosis. Treatment of Types II and III dislocations resulted in success in 46% of 13 cases, failure in 15%, and a fair or poor outcome in 39%. Considering Types IV, V and "combined" cases together, there were only two cases with good or excellent results (14% success) while 50% ended in failure.

TABLE VI.—RESULTS BASED ON AGE

	Failures	Poor	Fair	Good	Excellent
0-10 years	0	0	0	0	4
11-20 "	1	0	0	2	Ó
21-30 "	5	0	1	4	2
31-50 "	4	3	4	3	1
Over 50 yea	rs 2	2	1	2	0

The effect of age on the results of this injury is shown in Table VI. The trend here is less clear, though treatment of all four patients under 10 years of age gave an excellent result. In the 11 to 30 year group, successes numbered 53% but there was a 40% failure rate. In the 31 to 50 year group the success rate fell to a figure of 26% and the failure rate also diminished

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Fig. 1.—Avascular necrosis of the head of the femur two years and eight months after a Type V dislocation of the hip.

to that figure. In those over 50 years old similar figures obtained: 30% successes, 30% failures.

The interval between injury and reduction is considered in Table VII. There were no excellent results when reduction took place later than 12 hours after injury. Of the reductions within the 12 hour limit, 80% were successful (i.e. good or excellent). The three failures were in the following cases: two arthroplasties done at seven and 12 days for damage judged severe enough to lead certainly to failure, and one dislocation associated with fracture of the femoral neck in which avascular

TABLE VII.—RESULTS BASED ON INTERVAL BEFORE REDUCTION

	Failures	Poor	Fair	Good	Excellent
0-12 hours	3	0	1	8	7
13-24 "	3	2	1	2	0
1- 7 days	2	1	0	1	0
1- 4 weeks	2	2	1	1	0
Over 4 week	s 2	0	1	0	0

necrosis led to arthrodesis at six months. In the group in which reduction was delayed longer than 24 hours the figures were 15% successes and 46% failures. Of the six failures in this group one was associated with elective arthroplasty, one with an arthrodesis for arthritis, two with avascular necrosis and two with recurrent dislocation.

TABLE VIII.—RESULTS BASED ON PERIOD OF NON-WEIGHT-BEARING

	Failures	Poor	Fair	Good	Excellen
Under					
2 weeks	0	0	1	0	1
2-6 weeks	2	0	3	6	0
6 weeks to					
3 months	5	3	1	3	4
Over 3 mos.	. 2	3	1	2	0

In Table VIII, results are correlated with the non-weight-bearing period in 37 cas s. Little correlation is apparent. However, in the two to six week group there are fewer failures (18%) and more successes (54%)

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than in the six week to three month group (31% failures, 44% successes). Apart from the fact that these figures are based on small numbers of cases, the slightly improved results in the group prevented from weight-bearing for a shorter period may well be explained by the fact that these represent the relatively less severe injuries.

One fact of interest emerges from a consideration of the *length of follow-up* in relation to the result (Table IX).

TABLE IX.—RESULTS BASED ON LENGTH OF FOLLOW-UP

	Failures	Poor	Fair	Good	Excellent
0-2 years	10	0	0	1	2
0-2 years 2-1 "	2	2	0	3	1
4-3 "	0	0	1	5	3
Over 6 year	$^{\circ}$ 0	3	4	3	1

Eighty-three per cent of the failures occurred within two years of the original injury, with the remaining 17% occurring in the two to four year group. There were no failures – i.e. arthroplasties or arthrodeses – after four years. There did appear, however, to be a slight trend towards deterioration in the group followed up for over six years, where two of three poor results seemed headed for failure.

The occurrence of avascular necrosis (Fig. 1) was not always easy to determine since in late cases osteoarthritic changes were often so great as to obscure any more subtle evidence of avascularity. Avascular necrosis developed certainly in seven cases and probably in an additional five, for a certain incidence (in 42 cases) of 16%, a probable one of 29%. It is worthy of note that in only one instance of the 12 was reduction accomplished in under eight hours and this was the case of dislocation plus fracture of the femoral neck.

Radiological evidence of traumatic arthritis (Fig. 2) appeared in 14 cases and in an additional two there was clinical evidence of this change, an incidence of 38%. In eight cases the arthritis was marked.

Three arthrodeses were done for a third late complication seldom discussed in the literature: recurrent dislocation (Fig. 3). Each of these was a Type II or III dislocation, and in two instances redisplacement followed late open reduction and



Fig. 2.—Traumatic arthritis of the right hip nine years after a Type V dislocation.

screw fixation of the acetabular fragments. Myositis ossificans was never a problem in this series, and periarticular or capsular calcification of any extent occurred in only one case (Fig. 4). In five instances a very slight amount of calcification was noted on x-ray while in 20 instances there was none at all.

#### DISCUSSION

In this series the male sex preponderance, the age distribution and the frequency of motor accidents as a cause of the dislocation do not differ from previously reported series. To Mortality in the period of initial injury was 6.5% and in each of the four, death was not due wholly to the dislocation.

The dependence of the final result on the degree of damage associated with dislocation is apparent in this series, and



Fig. 3.—Recurrent dislocation of the left hip two months after open reduction and screw fixation of the posterior acetabular fragments.

the figures compare favourably with those given by Armstrong,¹ Thompson and Epstein¹⁰ and Stewart and Milford.8 Simple dislocation, without or with insignificant fracture of the acetabular rim, can be depended on to give 65 to 75% successes. Avascular necrosis will be the chief cause of failure in this group. Dislocation with fracture, on the other hand, will result in only 15 to 35% successes, those cases with fracture of the acetabular floor or the femoral head or neck having a particularly bad prognosis.

Open reduction and screw fixation of acetabular rim fragments has been encouraged<sup>5, 8, 12</sup> and was done in three instances: results included one failure, one fair and one good. Treatment of eight such injuries by closed methods failed once and gave three fair or poor and three good results and one excellent one. In defence of open reduction it should be pointed out that two of three reductions were done late and the third, done early, gave a good

result. It would appear that both treatments, judiciously applied, are capable of assuring good results.

The influence of age on the end result is not outstanding, although results in all four dislocations in children under 10 years old were excellent. These dislocations were all of Type I and were reduced in under nine hours from the time of injury. Paus has pointed to this association of uncomplicated dislocation and youth, and believes that end results are likely to be better in patients under 20 years of age. Stewart and Milfords on the other hand conclude from small numbers that results are not materially affected by the age of the patient.

Early reduction of dislocations is certainly second in importance only to degree of injury in influencing the end result. In this series there was only one failure (excluding two early arthroplasties which were elective) and one fair result in 19 cases in which the dislocation was known to have been reduced in under 12 hours from injury. The remaining 15 were good or excellent. These successes included four Type II or III dislocations and one Type IV. In 21 dislocations reduced later than 12 hours there were no excellent results and only four were good. Stewart and Milfords produced similar figures though their successes extended to the full 24 hour period after injury. Early reduction is also stressed by Ghormley and Sullivan<sup>4</sup> and by Thompson and Epstein.10 Paus's7 belief that reduction one to 10 days after injury has no definite influence on the end result must certainly be qualified by the assertion that reduction in one to 24 hours has a definite beneficial influence on the result.

The importance of restriction and avoidance of weight-bearing has always been of considerable interest. No conclusions are possible on the basis of the present series. Stewart and Milfords believe that vigorous active exercise in traction should be carried out for 10 weeks after reduction, followed by partial weight-bearing and then fill weight-bearing at three months. Ghormley and Sullivans state that prolonged prevention of weight-bearing does not necessar ly prevent aseptic necrosis. Thompson and Epstein, and Urist, were also unal le

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to relate the time weight-bearing was begun to the outcome. None of these conclusions is based on factual material, so that no recommendations with respect to this aspect of management can be made.

The seven sciatic nerve lesions with bjective signs all occurred in association with fracture of the acetabular rim, and in none was recovery complete. Ghormley and Sullivan,4 with 24 lesions, found "improvement" in 50% but in only one was recovery complete. Armstrong<sup>1</sup> noted the association of a displaced acetabular fragrient and sciatic nerve palsy in six of seven cases. In only one of his cases was recovery complete, and this followed exploration of the nerve on the fifth day. Stewart and Milford,8 on the other hand, noted "improvement" (25% to 75% recovery) in nine, and recovery in three of 15 cases, Urist12 reported "some recovery" in one of four lesions while Thompson and Epstein10 found that 14 of 26 "recovered" in three months to two years. Several authors1, 5, 8, 12 encourage exploration of the sciatic nerve especially if, two weeks after reduction, evidence of recovery of the nerve lesion is not apparent.

Of 12 failures, three were in cases of early arthroplasty done electively. Of the remaining nine, avascular necrosis either contributed to or was the sole reason for arthrodesis or arthroplasty in six instances; traumatic arthritis in three cases; redislocation or subluxation in three cases; and in one case the dislocation had never been reduced.

Analysis of 11 fair or poor results, on the other hand, reveals that in 10 cases post-traumatic arthritis contributed to or was the sole reason for the low classification, while in two avascular necrosis was contributory.

These observations, together with the fact that 10 of the 12 failures occurred within the first two years, suggest that the earlier, more dramatic and severe complication of avascular necrosis is much more likely to be associated with failure (i.e. arthrodesis or arthroplasty) than is the later, more gradual and less dramatic sequel of traumatic arthritis.



Fig. 4.—Periarticular calcification at the right hip three months after dislocation and two months after open reduction and screw fixation of the acetabular fracture.

# SUMMARY AND CONCLUSIONS

Sixty-two cases of traumatic dislocation of the hip have been reviewed, with followup information on 48 of these. Results of this analysis are compared with those of the larger series in the literature. In simple dislocation without fracture there is a preponderance of good or excellent results; this is not so in the more severe fracturedislocations. Youth and its association with simple dislocation allows a more satisfactory result. An excellent result was not obtained in any case where the dislocation was reduced later than 12 hours after injury. Good results were possible, however, after reduction in the 12 to 24 hour period. No conclusions with respect to the value of restricted weight-bearing after reduction are possible. The overall failure rate was 29%; 26% of results were fair ar poor; 45% were good or excellent. Sciatic nerve injury occurred in at least 16% of 62 dislocations. In lesions with objective signs recovery was never complete. Avascular necrosis occurred certainly in 17%, probably in 30% and was the commonest reason for failure (i.e. arthrodesis or arthroplasty). Traumatic arthritis occurred in 40% of cases followed up, and was the commonest cause of a fair or poor result. Re-dislocation or subluxation occurred in three cases and in each led to arthrodesis. Myositis ossificans occurred in one case, with a fair

The author is indebted to the many surgeons who permitted review of their cases and to Dr. F. P. Patterson and Dr. F. C. Preston for their assistance and advice. He is also indebted to Drs. J. R. Naden and J. D. Randall of the Workmen's Compensation Board of British Columbia for their interest and co-operation.

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# RÉSUMÉ

Les blessures et lésions des articulations porteuses conduisent fréquemment à des incapacites graves, et dans ce domaine, les lésions de la hancle sont les plus graves de toutes. Les luxations e cette articulation avec ou sans fracture se reicontrent de nos jours avec une fréquence accr e en raison du nombre des accidents de la route t de l'industrie. Pour tenter de déterminer le me leur traitement et les facteurs pronostiques, u e série de cas des hôpitaux de Vancouver a été passe e en revue, des années 1936 à 1956 inclusivement.

On comptait 52 hommes parmi les 62 malad s dont les observations sont présentées; les âg s des patients variaient entre 3½ et 77 ans, av c une moyenne d'environ 30 ans. La hanche droi e ce accidents avaient été provoqués, en ordre ce fréquence, par la route, l'industrie, les chutes ce lieux élevés, le ski, la luge et les autres sports. En ce qui concerne la classification par gravité, on établit les types suivants: type 1.-luxation simple rebord de la cavité cotyloïde; type 3.—luxation avec fracture du rebord de la cavité cotyloïde; type 3.—luxation avec éclatement du sourcil cotyloïdien; type 4. luxation avec fracture du col ou de la tête fé-morale; type 5.-luxation avec fracture totale du cotyle. A cause des difficultés qu'il y a de recon-naître exactement les types 2 et 3 à la radio-graphie, ces deux groupes furent rassemblés en un seul.

Dans 48 de ces cas, il fut possible de recueillir des informations ultérieures sur des périodes variant de 1½ à 11 ans. Dans l'ensemble, il y eut six morts dont quatre causées par des lésions multiples et deux, plus tardivement, par des affections sans rapport avec l'accident.

Les résultats furent considérés comme "excel-nts" lorsque l'examen clinique et radiologique et les déclarations du patient montraient que tout était redevenu normal. Les résultats furent étiquettés "médiocres" lorsqu'il y avait persistance de la douleur, incapacité partielle, changement d'emploi en rapport avec l'accident, ou des signes d'ostéoarthrite ou de nécrose.

Enfin, le traitement orthopédique fut déclaré inefficace lorsqu'une opération devint nécessaire. Les résultats sont dits "bons" lorsqu'ils se situent entre le "médiocre" et "l'excellent". Tout ceci est résumé dans le Tableau IV.

Le Tableau V fait ressortir la valeur des résultats en fonction du degré de gravité de la lésion; le Tableau VII, en fonction de l'âge des malades; le Tableau VIII, en fonction du temps de latence avant l'instauration du traitement.

La fréquence de troubles vasculaires entraînant de la nécrose fut difficile à déterminer avec pricision car l'apparition de signes ostéoarthritiques gênait souvent les interprétations. Cependant cet e complication apparut avec certitude dans sept cas.

Il y eut également 14 cas d'arthrite traumatique et trois cas de luxation récidivante.

L'auteur donne ici une revue de la littératu e sur la question; dans l'ensemble, les résultats qu'il présente correspondent à ceux des autres public :-

Parmi les facteurs qui peuvent aider da s l'établissement du pronostic, il faut tenir comp e de la gravité de la lésion, de l'âge du patient et de la rapidité de la mise en œuvre du traitemer t.

# TEFLON FABRIC FOR LIGAMENT RECONSTRUCTION: AN EXPERIMENTAL STUDY°

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THERE IS A NEED for a more satisfactory naterial for the repair of a neglected torn ligament. Teflon fabric (poly-tetra-fluoro-e hylene) is an inert slippery woven material, which produces a minimal tissue reaction. Let It is strong, retains its tensile strength after implantation, and is superior in flex abrasion resistance. It has been used for blood vessel prostheses, and in the repair of hernial defects.

It was proposed to use teflon fabric as a prosthetic ligament, and to study at intervals the joint reaction to teflon and its suitability as a prosthetic ligament.

# MATERIALS AND METHODS

Nine adult mongrel dogs, fed a standard laboratory diet, were used for this experiment. The medial collateral ligament of the knee was found to be the most useful for this study. The knee of a dog is anatomically similar to a human knee, but differs functionally in that the knee is not fully extended during ambulation or standing. The opposite knee was used as a control. Tubular teflon fabric 8 mm. in width with a breaking strength of 115 lb. was used for a prosthetic ligament.

Under general anæsthesia with intravenous pentobarbital (30 mg./kilo), and tourniquet ischæmia, a curved skin incision was made over the medial aspect of the knee. The insertion of sartorius was partially divided and the muscle retracted posteriorly, exposing the medial collateral ligament. The entire ligament with the immediately adjacent capsule was excised. Slight flexion of the knee and a forceful valgus strain produced medial joint widening, illustrating that the medial support of the joint had been removed.

In five of the dogs a trap door was made in the tibia and femur, at the previous insertion of the ligament (Fig. 1).

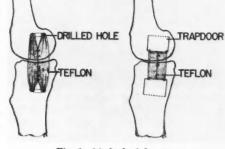


Fig. 1.-Method of fixation.

These trap doors of bone opened toward the joint. Two pieces of teflon were then inserted under the trap doors, and the closed trap door was fixed by a few silk sutures passed through the bone. The



Fig. 2.—External appearance of joint showing band of adherent scar overlying teflon ligament.

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<sup>&</sup>lt;sup>o</sup>From the McEachern Cancer Research Laboratory and Department of Orthopædic Surgery, University of Alberta, Edmonton, Alberta.

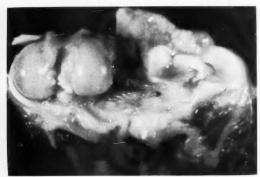


Fig. 3.—Internal appearance of joint showing thin glistening membrane partially covering teflon ligament.

edges of the teflon were sutured to surrounding capsule. In the remaining dogs, two holes were drilled into the tibia and the femur, and the teflon threaded through the holes and sutured to itself and the surrounding capsule. An integral portion of the joint capsule therefore consisted of teflon fabric, replacing the excised ligament. A medial strain upon the joint did not produce a valgus deformity, demonstrating restoration of joint stability. The wound was closed and the limb immobilized in a single hip spica for three weeks.

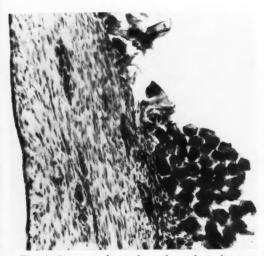


Fig. 4.—Intra-articular surface of prosthetic ligament showing teflon fabric in cross section on the right, and on the left young fibrous tissue lining the internal surface of the ligament (x 100).

Four of the animals were sacrificed four weeks postoperatively and the remainder at 12 weeks. Both hind limbs were amputa ed through the proximal third of the femur. The foot was removed through the lover third of the tibia, and all muscle exci ed from the remaining specimen. The joint capsule and knee ligaments were divid d, except for the teflon and adherent sar of one limb, and the medial collateral ligament of the opposite limb. It was then possible to test the strength of the prosthetic ligament and use the medial ollateral ligament of the opposite knee of the same dog as a control. Ligament strength was tested in co-operation with the Department of Civil Engineering, using the Baldwin Hydraulic Tester No. 6-35. The tibia and femur were placed in the chucks of the machine and an increasing pull exerted. The breaking strength was recorded as the number of pounds required to break the ligament.

# RESULTS

The following criteria were used for evaluation:

- 1. Gait.
- 2. Range of knee motion.
- 3. Measurement of abduction at the knee, resulting from a valgus strain.
  - 4. Signs of joint reaction.
- 5. Breaking strength of the prosthetic ligament and control ligament from opposite knee.

Gait.—All dogs limped upon removal of the plaster cast. One week later none limped and they were able to run about normally.

Range of motion (Table I).—All of the dogs had limitation of flexion when immobilization was discontinued. Moderate restriction of flexion persisted in some of the animals, but did not produce a limp.

Abduction.—Any laxity of the ligament was measured by forcefully abducting the tibia upon the femur and measuring the valgus deformity in degrees, using a geniometer. One dog developed a lax ligament with a deformity of seven degrees. In this case the dog chewed the cast off and walked without immobilization on the first postoperative day.

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TABLE I.—Joint Motion after Surgery
(IN DEGREES)

	Dog	A.G.F.	A.G.E.	Abduction
4 weeks	1	90	180	3
	2	15	180	$\frac{2}{3}$
	3	90	180	3
	4	20	180	2
	5	90	180	0
weeks	6	30	180	7
	7	15	175	0
	8	10	180	0
	9	10	180	0

Normal angle of greatest flexion (A.G.F.) = 10Normal angle of greatest extension (A.G.E.) = 180Normal abduction = 0-3

Joint reaction.—Upon removal of the paster cast there was a small degree of local induration present about the operative site. There was no heat or tenderness, but the animals showed resentment at the extremes of joint motion. All signs of tissue reaction had subsided one week later.

Examination of the area revealed a band of scar overlying and intimately attached to the prosthetic ligament (Fig. 2). There was no joint effusion. The synovium appeared slightly ædematous. The internal surface of the teflon was partially covered by a very adherent, thin, glistening membrane extending from both the tibial and the femoral attachments of the prosthesis. The teflon was not covered opposite the femoral condyle, where most movement occurs (Fig. 3).

Twelve weeks postoperatively there was no gross evidence of joint reaction. Twelve weeks after insertion of the teflon prosthesis, microscopic examination revealed a minimal synovial reaction. The surface in contact with the joint was covered by a layer of young connective tissue (Fig. 4). The fabric which was buried in bone was held by mature connective tissue.

Breaking strength.—In all cases but one the teflon pulled loose from its attachment. In the single case in which the fabric remained attached to bone, but tore across at the joint line, it broke at 110 lb., 5 lb. less than the breaking strength of the

material used.

It has been subsequently found that threading the fabric through drilled holes as previously described, and then tying the fabric with a square knot, followed by suturing the tied ends to neighbouring teflon, provides an adequate method of

# DISCUSSION AND CONCLUSIONS

Joint reaction to teflon fabric was studied by replacing the excised medial collateral ligament of the knee with teflon fabric, so that a portion of the joint capsule was replaced by teflon. Clinical and histological observations indicate that teflon produces a minimal joint reaction.

Adequate fixation may be obtained by threading the fabric through drilled holes situated at the normal insertion of the ligament, tying the fabric to itself and suturing the tied end to nearby teflon. The prosthetic ligament does not become lax.

Owing to the acceptance of teflon by a joint, it may find a useful place in the repair of damaged intra-articular structures, as well as in certain forms of tendon repair.

# SUMMARY

The excised medial collateral ligament of the knee of dogs was replaced with teflon fabric. Joint reaction and the suitability of teflon as a prosthetic ligament were studied.

It was found that teflon fabric produces a minimal joint reaction. It may be adequately fixed by threading the fabric through holes drilled at the insertion of the ligament, tying the fabric to itself, and suturing the tied ends to neighbouring teflon. The prosthetic ligament did not become lax.

It is concluded that teflon is accepted by a joint, and may find a useful place in the repair of damaged intra-articular structures and in certain forms of tendon repair.

#### ACKNOWLEDGMENT

Technical assistance of Mr. W. R. Browne of the Department of Civil Engineering, University of Alberta, is gratefully acknowledged.

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# RÉSUMÉ

Le teflon (polytétrafluoroéthylène) est un tissu de fibre synthétique inerte employé en chirurgie vasculaire et dans la correction des hernies. Les vasculaire et dans la contection des inclines auteurs ont pensé s'en servir dans la plastie ligamentaire des grosses articulations.

Le ligament latéral interne du genou fut enlevé

chez neuf chiens adultes et remplacé par des

bandes tubulaires de teflon. Dans cinq cas el es furent insérées sous un volet osseux et leurs bo ds cousus à la capsule articulaire. Dans les qua re autres cas, la stabilité fut assurée par fixat m trans-osseuse du tibia et du fémur; les extrémi és des bandes furent nouées ensemble et cousues à elles-mêmes.

Une semaine après l'enlèvement du plâtre es animaux ne souffraient plus d'aucune claudication. On observa une certaine limitation de la flex m sans toutefois gêner beaucoup la mobilité de l'ar jculation. Le seul relàchement manifesté par in valgus de 7° se trouva chez un chien qui avuit détruit son plâtre et s'était mis à marcher avant la guérison des tissus. Les très légers signes d'infla amation causés par la présence de teflon disparurent en une semaine. L'examen anatomo-pathologique montra une prothèse dont la surface interne ét it recouverte par une membrane mince, luisarte et bien adhérente. Les auteurs sont d'avis que teflon pourrait être employé avec profit dans la chirurgie réparatrice des articulations.

# CHRISTENING BY CONJECTURE\*

"There are far subtler problems of meaning than those arising from mishandled words. Consider the apparently straightforward term 'ruptured plantaris syndrome'. We all know it means the collection of symptoms caused by rupture of the plantaris muscle. And, what is more, we all know the syndrome. There is sudden pain in the calf-so sudden that the sufferer, if walking in the street, looks round to catch the urchin who threw a stone at him. A few hours later the calf is black and blue, and it remains painfully swollen for weeks. The name seems admirable too, does it not? No obscurity, no difficult words, no doubts.

"But you are wrong. There is the most profound obscurity, there is the greatest difficulty, there are the most grievous doubts. An abominable semantic crime has been committed: a single term has been knowingly applied to two completely different things without making the slightest effort to determine whether the one is equal to the other, or even related to the other. A pathological process and a collection of symptoms have been given the same name. . . .

". . . It illustrates a fault in nomenclature which causes more trouble than any other of the semantic abuses which are committed by medical men. Because the name of a pathological process (rupture of the plantaris) has been placed upon a syndrome (sudden unexplained pain and bruising), we are in an impossible position. We do not know to which it applies-the pathology or the symptoms-and so we are convinced, unthinkingly and uncritically, without a shred of evidence, that the one causes the other. It is immaterial to my argument whether or not rupture of the plantaris muscle does really cause these symptoms; yet all the same you may be interested to learn that it almost certainly does not. I have searched the literature and found one genuine case of ruptured plantaris muscle<sup>†</sup> (N. 3. —I mean muscle, not syndrome)."

CROCE, E. J. AND CARPENTER, G. K.: J. Bone & Joint Surg., 26: 818, 1944.

<sup>\*</sup>Asher, R.: Making sense, Lancet, 2: 361, 1959.

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# EXPERIMENTAL STUDIES ON THE PRODUCTION OF DEEP HYPOTHERMIA BY MEANS OF A PUMP OXYGENATOR AND HEAT EXCHANGER WITH A NOTE ON THE CLINICAL APPLICATION®

R. O. HEIMBECKER, M.A., M.D., F.R.C.S.[C], F.A.C.S., W. E. YOUNG, M.D. and D. C. SANFORD, B.Sc., Toronto

THE PRODUCTION OF general hypothermia by the cooling of circulating blood was s ggested independently by Delorme and Collan in 1952.3, 5 Early efforts to combine total body perfusion and hypothermia were partially successful but animals cooled below the 22-27° C. range rarely survived.3-5 In 1954, Gollan cooled open chest dogs successfully to 24° C., but noted a high is cidence of postoperative hæmorrhage. Later Peirce stressed the value of combining low flow rates and hypothermia.6, 7, 12 Creat impetus was given the subject when Brown, Sealy et al. described the use of a heat exchanger which permitted rapid cooling and rewarming and gave repeated success at moderate levels of hypothermia.8-11

The purpose of the present study was: firstly, to attempt to define the degree of cold that non-hibernators can tolerate if the circulation is supported completely; secondly, to study the oxygen consumption at these extreme levels; thirdly, to evaluate the role which deep hypothermia may play in the repair of intracardiac defects under direct vision.

# Метнор

Mongrel dogs weighing 15-20 kg. and of varied ages were anæsthetized by intravenous thiopentone (Pentothal). After intubation they were ventilated with an intermittent positive pressure apparatus. The depth of anæsthesia was gauged so that the animals were at the point of waking at the onset of cardiac by-pass.

Highly purified heparin† in dosage of 1.5 mg./kg. was given when the cannulæ were inserted and Polybrene‡ in equal

dosage was employed later, to neutralize the heparin. The pump oxygenator consisted of a modified Cooley type of stainless steel bubble oxygenator mounted on a Pemco roller pump unit (Fig. 1). The heat exchanger to the right of the oxygenator is our new modification built especially to give greater heat transfer.\* Thirty thin-walled stainless steel tubes 18 in. (45 cm.) long are mounted in a water jacket through which the refrigerant solution flows. The priming volume of blood is only 70 c.c. greater than with earlier models,8 but the efficiency is estimated to be increased 50% (Fig. 2). Cooling is accomplished by circulating refrigerant solution at 0° C. from a standard Thermorite unit into the heat exchanger. Fluid at 41° C. is pumped from the Thermorite to rewarm the blood.

The surgical procedure consisted of a right thoracotomy. Plastic cannulæ were inserted in superior and inferior venæ cavæ. A stainless steel arterial cannula was used to deliver blood into the femoral artery. At the onset of cardiac by-pass a right atriotomy was performed and a coronary sinus sucker inserted across the tricuspid and pulmonary valves into the main pulmonary artery. This technique was essential to keep the left heart decompressed once "cold asystole" was produced. Efficient cardiac decompression was mandatory for the preservation of good cardiac function during rewarming, and in the prevention of pulmonary complications.

Temperatures of brain, heart, œsophagus, rectum, muscle and perfusion blood were constantly monitored by needle electrodes and the Electrolaboriat thermometer.† Electrocardiogram, electroencephalogram, and venous and arterial pressures were also recorded.

<sup>&</sup>lt;sup>o</sup>From the Department of Surgery, University of Toronto.

This study was supported by the Ontario Heart Foundation, the Bickell Foundation and Federal Health Grants.

<sup>†</sup>Courtesy Upjohn Co. Ltd.

<sup>‡</sup>Courtesy Abbott Laboratories.

<sup>\*</sup>Obtainable from Canadian Pipe & Steel Fabricators, 160 Duchess St., Toronto 2.

<sup>†</sup>Electrolaboriatet Co., Copenhagen, Denmark.

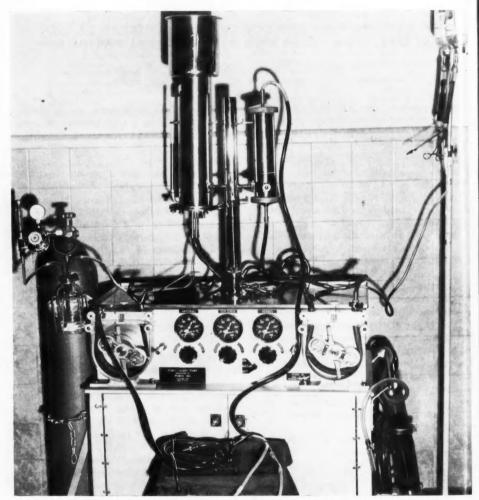


Fig. 1.—Bubble oxygenator (left) and heat exchanger (right) mounted on DeBakey roller pumps.

The oxygen contents of arterial and mixed venous blood were measured by the method of Van Slyke. By applying the Fick principle to the arteriovenous oxygen difference and the established flow rates, the oxygen consumptions at various temperatures were calculated.

# OBSERVATIONS

Complete experiments were carried out on 12 consecutive dogs. Fig. 3 demonstrates the cooling-rewarming sequence in a typical case. A myocardial temperature of 8.5° C. was achieved in 24 minutes and return to

37° C. in a further 45 minutes. In all our cases, heart, œsophageal and brain temperatures paralleled each other within 1° C. By contrast, rectal and muscle temperatures lagged by 10° to 15° C. during the cooling phase and by 5° to 8° C. on rewarmin 5. The rewarming phase was consistent ylonger than cooling by 10 to 20 minutes. This is explained by the low heat exchanger temperature (0° C.) which the blood will tolerate without serious damage. One hestates on the other hand to exceed 40-41° C. on rewarming the blood because of the danger of hæmolysis.

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The graph also demonstrates how the muscle masses may act as a heat exchanger and produce a drift downwards of the vital organ temperature to as low as 30° C. following the period of by-pass.

Observations on myocardial action were of great interest. In three cases no ventricular fibrillation occurred in any phase of the experiment! Ventricular fibrillation developed at the 16-20° C. range in the others. Fibrillation ceased and asystole resulted once the temperature reached 10-12° C. In the three cases in which no fibrillation occurred, a gradually increasing sinus bradycardia developed, followed eventually by asystole. It is remarkable to observe the still heart encased in a cast of congealed epicardial fat at this extremely low temperature. On rewarming, fibrillation was often seen: however, one shock of 220 volts applied once the heart was rewarmed to 30° C. usually defibrillated the heart. Spontaneous reversion to sinus rhythm after 'cold asystole" was observed in three cases. Calcium salts and adrenaline were occasionally required to stimulate a lagging heart.

Oxygen consumption studies were carried out at temperatures ranging from 8.5° to 10° C. on the last six animals. The results are shown in Table I. The basal oxygen requirement for each animal is calculated from body weight. By comparing the measured oxygen consumption at hypothermic levels the percentage requirement is obtained. The average requirement of oxygen at these temperatures ranges from 3% to 15% of the basal. These figures are accurate only within the reliability of the Van Slyke method of blood gas analysis in the presence of small arteriovenous differences.

Fig. 4 has been adapted from Bigelow's early work on oxygen requirements at the usual clinical range of hypothermia.<sup>13</sup> It demonstrates how the curve of oxygen requirement can be continued to its end point by plotting the figures from the present study.

# RECOVERY

Of 12 dogs all but one were awake and active with normal blood pressures one hour after the procedure. Three died of pulmonary collapse and pneumonia in 48

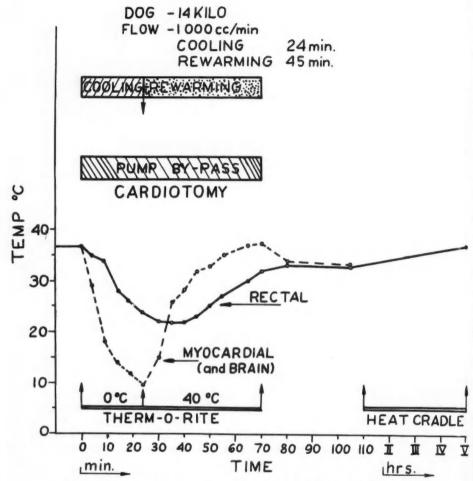


Fig. 3.—Illustrates the temperature gradients which develop within the body during blood cooling. Vital areas reached 9.5° C. in 24 minutes. "Cold asystole" developed with no preceding cardiac arrhythmia.

hours. Five died of hæmorrhage within 12 hours. These would likely have survived if blood replacement had been available during the night. One operative death due to irreversible ventricular fibrillation occurred. One animal was alive and perfectly normal one month after cooling to 8.5° C. When the animal was sacrificed, histological sections of brain, heart, liver, and kidneys were normal.

It is generally recognized that dogs tolerate cardiac by-pass poorly, compared with human beings. It is likely that with

the use of healthy animals and the avoidance of pulmonary collapse during the procedure, followed by meticulous hæmostasis and by intensive postoperative care and blood replacement, long-term survivals could be consistently achieved. Survival experiments are continuing.

#### CLINICAL APPLICATION

Several authors have reported the combined use of heat exchanger and pump oxygenator for temperature control during open heart surgery. The value of the temperature control that the several control is a several authors have reported the combined authors are several authors have reported the combined authors are several authors have reported the combined authors ha

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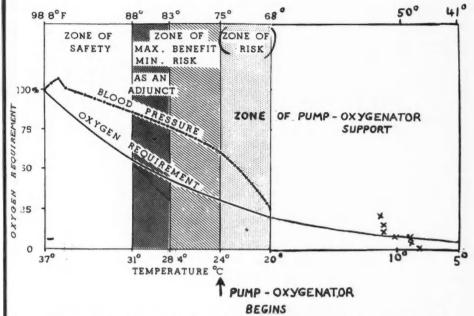


Fig. 4.—Hypothermia with "pump". Oxygen requirements fall in a linear fashion as the temperature falls, The temperature zone of risk becomes safe with the use of the pump oxygenator to support the circulation, (Adapted from paper of W. G. Bigelow.)

nique depends on having a unit which adds little to the length of by-pass by virtue of a very high efficiency of heat transfer. It must also have the qualities of low priming volume, of minimal blood trauma, and of being readily cleansed. The present unit fills these criteria well. Adult patients requiring flow rates up to 3000 c.c. have been rapidly cooled and rewarmed with no adverse effects. The need for deep hypothermia has not yet arisen. Most patients are cooled to 29-30° C. Fig. 5 illustrates a case of mitral annuloplasty in an adult

patient, who was cooled to 29.5° C. in the first four minutes of perfusion and rewarmed during the last ten. Since this technique has been adopted the course of the patients in the recovery room appears to be improved. They seem more alert and active, and there is less tendency to shivering. The ensuing metabolic acidosis is less.

# FUTURE APPLICATIONS

1. By combining hypothermia and low flow rates simpler and smaller pump oxygenators may be practical.

TABLE I.—OXYGEN REQUIREMENTS IN DEEP HYPOTHERMIA

Doy	Lowest myocardial temp. ° C.	$_{c.c./min.}^{Flow}$	$Basal$ requirement $O_2$ c.c./min.	A-V difference vols. %	Hypothermic requirement $O_2$ c.c./min.	% of basal requirement
No. 12	12.0°	1200	140	1.8	22.0	15.0
No. 11	10.0°	1000	115	2.4	24.0	20.0*
No. 10	8.5°	1200	115	0.06	0.7	0.6
No. 9	10.0°	1100	125	0.9	9.9	8.0
No. 8	8.5°	1200	130	0.32	3.8	3.0
No. 7	10.0°	1000	112	1.98	19.8	5.0
No 6	12 0°	1000	150	1.3	13.0	9.0

The wide range of oxygen requirements seen in the last column is due to considerable variation in the temperature gradients throughout the body. It is also influenced by the inability of the Van Slyke method to measure small A-V differences accurately.

\*Likely laboratory error.

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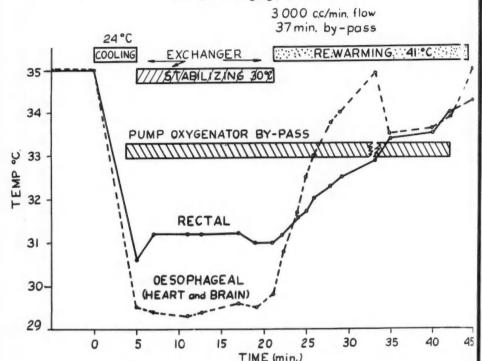


Fig. 5.—The heat exchanger permitted this adult patient to cool to 29.5° C. in four minutes! This temperature was then beautifully maintained throughout the open heart procedure. Rewarming began towards the end of the procedure and was rapid and complete.

2. In certain cases of cyanotic congenital heart disease, the presence of tremendous collateral blood flow seriously lowers the perfusion pressure when the usual flow rates are employed. By inducing hypothermia rapidly, an inadequate perfusion can quickly become an adequate one. The problems of a bloody operative field, high coronary sinus return, and hæmolysis from elevated perfusion rates are thereby avoided.

3. Similarly, an unexpected loss of perfusion volume via an unrecognized patent ductus or left superior vena cava may be coped with.

4. On occasion an arterial cannula of smaller than adequate size must be inserted because of hypoplastic vessels. The risk of high turbulent flow through the small cannula can be averted by employing hypothermia and a low flow.

5. Finally, the technique of producing deep hypothermia in the 10-12° C. range is of great interest and the prospect of prolonged periods of complete circulatory arrest is very appealing.

Such heat exchangers will soon become an integral part of every pump oxygenator. Only in this way can temperature be accurately controlled at all times. Only in this way can hypothermia be rapidly and safely induced to any desired level. Lewarming is equally facilitated.

#### SUMMARY

The technique of producing deep hyl othermia using a pump oxygenator and a new efficient heat exchanger is described. The importance of adequate, continuous, cardiac decompression is stressed. The surprisingly low incidence of serious card ac arrhythmia is described. Experimental ani-

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VI 0ic a bed. 0 15, S IId ac a nimals have been cooled to 8.5° C. and rewarmed, with long-term survival. Studies snow that oxygen requirements at these levels range from 3% to 15% of basal requirements. The clinical applications to open heart surgery now and in the future are presented.

The authors wish to thank Miss McMeekan, r. Burley and Mr. Benoit for their valuable a sistance.

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#### RÉSUMÉ

Le but de la présente étude est de déterminer: le degré de froid que des animaux non hivernants peuvent supporter; la consummation d'oxygène à de tels refroidissements; et enfin, l'aide que peut apporter l'hypothermie intense à la chirurgie

Pour la partie expérimentale, on utilisa des chiens de 15 à 20 kg., d'âges divers, anesthésiés par du thiopental intraveineux. Après intubation la respiration était maintenue et controlée à l'aide d'un appareil à pression positive intermittente. Les animaux recevaient de l'héparine à la dose de 1.5 mg./kg. La pompe oxygénatrice était un modèle de Cooley modifié, et l'échangeur de température était spécialement construit (les références des constructeurs de cet équipement sont données). Les chiens subirent une thoracotomie droite; des canules en plastique furent insérées dans les veines caves supérieure et inférieure, le sang fut amené à l'artère fémorale par un trocard à ponction en acier inoxydable; une atriotomie droite fut alors accomplie, par laquelle on aspira le sang du sinus coronaire, technique essentielle à l'obtention de la décompression du cœur gauche. Les températures du sang perfusé, du cerveau, du cœur, du rectum, de l'œsophage et des muscles furent enregistrées, de même que l'électroencéphalogramme, l'électrocardiogramme et les pressions artérielles et veineuses. Des dosages d'oxygène artériel et veineux furent faits selon la méthode de Van Slyke.

Les animaux en expérience furent ainsi refroidis jusqu'à 8.5° C., puis réchauffés dans un second temps; le temps de réchauffement fut généralement de 10 à 20 minutes plus long que celui du refroidissement. Il y eut un taux étonnament bas d'arythmies cardiaques. Les dosages d'oxygène montrèrent que les besoins sont abaissés à une valeur de 3 à 15% des besoins basaux normaux.

Les applications pratiques de ces essais sont alors discutés; parmi celles-ci, la possibilité d'employer des oxygénateurs simples, et de prolonger le temps d'arrêt circulatoire réel par un hypothermie dans la région des 10-12° C.

# MALIGNANT DUODENOCOLIC FISTULA®

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FISTULA FORMATION between the duodenum and the colon may be secondary to a benign condition such as ulcer or diverticulum, or to a malignant neoplasm in the involved or adjacent organs. We are reporting what we believe to be the 39th published case of malignant duodenocolic fistula.

# CASE REPORT

A 52 year old accountant was admitted to the Queen Mary Veterans' Hospital on June 2, 1958, with a history of several episodes of abdominal pain, nausea and diarrhœa over a period of 18 months.

Past and family histories were non-contributory. Since the beginning of his illness, investigations had revealed: (1) mild epigastric and peri-umbilical tenderness on palpation; (2) normal hæmatological and blood chemistry values; (3) deformity and irritability of the duodenal cap on barium meal examination; (4) radiological evidence of diverticulosis of the sigmoid and descending colon. The episodes of pain, nausea and diarrhœa occurred once every two to five weeks associated with excessive flatulence and a feeling of tension in the epigastrium. On one occasion, while in hospital, he developed subacute large bowel obstruction. This subsided rapidly under conservative management and was ascribed to an attack of diverticulitis. His general condition had been good until two months before admission when the patient started complaining of weakness and "lightheadedness". There had been no impairment of appetite. A slight weight loss of 4 lb. in three months was noted.

Physical examination was negative except for epigastric tenderness. Weight: 142 lb. Laboratory procedures: urine normal - blood urea nitrogen (BUN) 8.4 mg. %-serum cholesterol 151 mg. %-bromsulphalein (BSP) 8.4% dye retention in 30 minutes-total serum proteins 5.98 g. % (albumin 4.22 g. %, globulin 1.76 g. %)—RBC 4.16 million/c.mm.—hæmoglobin value 11.8 g. % (75.6%)-WBC 8800/c.mm.erythrocyte sedimentation rate (ESR) 16 mm. in one hour-hæmatocrit 40%-test for occult

blood in fæces strongly positive on two occasions-ECG normal. On x-ray examination, t e chest was normal. A barium enema (Fig. showed "incomplete obstruction at the hepaic flexure, very suggestive of a carcinoma" (Ir. W. Klumper). An upper gastro-intestinal series revealed no other abnormality than slight narrowing in the superior portion of the descending duodenum.

A laparotomy was performed on June 20 (C. McG. G.). A large carcinomatous mass was found in the transverse colon close to the hepatic flexure. It almost occluded the colonic lumen as well as the second portion of the duodenum just distal to the ampulla of Vater. In addition, the terminal ileum, cæcum and pancreas were adherent to the tumour. Numerous metastatic nodules were seen on the liver surface. Widespread lymph node involvement was also present. An enlarged node was removed for tissue diagnosis but resection was not attempted and the abdomen was closed. Pathological examination of the biopsy material confirmed the diagnosis of adenocarcinoma. The postoperative period was marked by a slight transient elevation of temperature and persistent moderate anæmia with hæmoglobin values between 11 and 12 grams per 100 ml.

The patient was discharged for personal reasons but re-admitted 12 days later on July 16, 1958, with a provisional diagnosis of large bowel obstruction. He had passed no stool or gas by rectum for three days and had repeatedly vomi'ed fæcal material. He also complained of foul eructations. Tenderness was again present in the epigastrium and moderate abdominal distension was noted in both right quadrants. His weight was now 123 lb., a loss of 19 lb.

Laboratory findings: RBC: 3.4 million/c.mm. -hæmoglobin value 11.25 g. % (72.1%)-hæmatocrit 35%-ESR 30 mm. in one hour--WBC 14,950/c.mm.—BUN 10.4 mg. %—Cl 101.4 mEq./l.—Na 137.1 mEq./l.—K 3.65 mEq./l.—CO<sub>a</sub> combining power 34.8 mEq. l. (78 vol. %).

Treatment was instituted by intermittent nas gastric suction, fluid and electrolyte replacement and blood transfusions. Initially and quite reasoably the patient refused any further surgery ard he was treated conservatively for 12 days. Aspirated material was frankly fæcal and w.s. collected in large quantities. The possibility of a duodenocolic fistula was entertained at this point and a few mouthfuls of barium mixtu e

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were given orally, to be followed by x-ray examination twice daily. This passed normally from the stomach into the duodenum and small bowel, and was concentrated in the ascending colon after 48 hours (Fig. 2). Complete obstrated but no evidence of an abnormal communication between the duodenum and the colon was found.

On July 28, when the patient consented to pallitive operation, a cæcostomy was performed and normal food intake resumed. His general condition improved and he was allowed to go home. The cæcostomy was active four to six times a div.

He was admitted for the last time on September 10, 1958, because of severe erosion of the skin around the cæcostomy opening, which had become quite unmanageable at home. His weight was still 123 lb. After a few days, he developed explosive post-prandial containing coarse undigested food particles. The presence of a duodenocolic fistula was finally demonstrated by barium meal examination (Fig. 3). The fluoroscopy report read: "The barium was seen to flow through the pylorus freely, then into the second portion of the duodenum. From there it flowed through a large fistulous tract into loops of large bowel and at the same time continued along the third portion of the duodenum. The fistulous tract measured approximately 4 cm. in length by 2 cm. width. It is related to the mid-part of the second portion of the duodenum". (Maj. J. Y. Reid, RCAMC).

A colostomy bag was fitted and the patient released from hospital once more at his request. At that time, the BUN, serum proteins and electrolytes were well within normal limits.

Subsequently, the patient travelled by air to the United Kingdom where he died on November 8, 1958, in a state of progressive dehydration, anæmia and weakness. No autopsy was performed.<sup>13</sup>

# DISCUSSION

In this case, the development of a duodenocolic fistula was suspected at the second hospital admission because of: (1) the laparotomy finding of a cancer involving simultaneously the colon and the duodenum; (2) the foul eructations and the presence of fæcal material in the vomitus and gastric aspirate; (3) the large bowel obstruction associated with very little distension.



Fig. 1.—Barium enema, June 5, 1958. Carcinoma of the hepatic flexure.

It was impossible to demonstrate a fistula by x-ray studies with oral barium. No barium enema was given because obstruction was obviously complete and distal to the suspected lesion. However, we believe that the fistula was already present but permeable in one direction only (i.e. from colon to duodenum), which would explain both clinical and radiological findings. After the execostomy, the fistula still did not allow transit from duodenum to colon. Further evolution of the malignant tumour caused the tract to enlarge, unmistakable symptoms appeared and positive proof of the fistula was obtained.

The patient's condition remained remarkably good at first and he was able to fly across the Atlantic to England. This was undoubtedly due to two factors: (1) a sufficient portion of the duodenal contents was directed past the fistula into the small bowel; (2) the presence of obstruction in the distal transverse colon coupled with a cæcostomy prevented excessive loss of fluid and electrolytes through diarrhœa. At the

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Fig. 2.—Follow-through of small barium meal, July 23, 1958. The opaque mixture fills the ascending colon, appendix and lower ileum. Note thin barium showing in stomach, duodenum and upper jejunum. A calcified node is seen opposite the transverse process of L3.

time of death, it was evident that severe impairment of nutrition and hydration had resulted from the fistula.

Malignant duodenocolic fistulæ are not common (although the benign variety appears to be even rarer). We have found only one other recorded case in the major hospitals of Montreal.<sup>17</sup> Of approximately 1400 cases of carcinoma of the right colon studied by Calmenson and Black¹ in 1947, two were complicated by duodenocolic fistula. In 1951, Hershenson and Kirsners collected 21 cases in a survey of the literature. Since then, 17 cases have been published, ° so that ours brings the total to 39.

Table I shows the site of the primary tumour in all cases. The predominance of colonic carcinoma is not surprising in view

\*One additional case was reported by Halligan in 1950, but we were unable to procure the reference.

TABLE I.—Site of Primary Tumour in Malignant Duodenocolic Fistula (adapted from Hershenson and Kirsner)

Origin	Males	Females	Tota
Colon	27	5	32
Duodenum	(sex un	specified)	1
Gall-bladder	0	1	1
Undetermined	3	2	5
Total	30	8	39

of the relative frequency of cancer of the involved organs. The right half of the large bowel was involved in all cases, the usual locations of the fistulous openings being the hepatic flexure area and the second portion of the duodenum. The male-to-female ratio is much higher than that found in malignancy of the right colon in general, as previous reviewers\* have already pointed out. The mean age of all patients was 53.7 years, with extremes of 27 and 74.

TABLE II.—CLINICAL FEATURES OF MALIGNANT DUODENOCOLIC FISTULA (modified from Hershenson and Kirsner)

Finding		I	ıci	den
Diarrhœa	 			3
Weight loss	 			2
Abdominal pain	 			. 2
Anæmia	 			. ]
Vomiting	 			_ 1
Undigested food in fæces				
Fæcal emesis and/or eructations	 			
Abdominal mass	 			

Table II summarizes the incidence of the main clinical features of the disease. The statistical value of those figures is unfortunately altered by the incompleteness of many reports.

Diarrhœa is a prominent symptom in almost all cases. Its distinguishing features are severity and persistence. However it is not specific and may be related to the original neoplasm. Sometimes diarrhæa alternates with bouts of constipation, and in one instance cases, including our spresented a syndrome of obstruction before the fistula was diagnosed. 1, 18

Weight loss is mentioned 29 times and is probably always present. Again this may be due to the causative lesion, but it is undoubtedly aggravated by the short-circuiting of food and the intense diarrhæa.

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The next most frequent symptom is al dominal pain. It varies in degree from m'ld distress to severe cramps and is usually felt in the epigastrium or right upper quadrant. In itself, it does not necessarily suggest an internal fistula. Anæmia and vomiting may also be associated with uncomplicated cancer of the colon.

The key symptoms of duodenocolic fis ula—the presence of undigested food in faces and fæcal eructations or vomiting—were mentioned in little more than one cale in five. It is not surprising therefore that such lesions are seldom suspected clinically.

Other manifestations are infrequent and may confuse the picture, such as ædema with hypoproteinæmia, acholic stools due to the location of the duodenal orifice above the ampulla, and severe malnutrition which mimicked non-tropical sprue.

X-ray examination is usually required to establish the diagnosis. Indeed, a good number of cases have been reported by radiologists who demonstrated the lesion conclusively. This may be done by means of a barium meal, but the barium enema seems to be the more effective procedure.

The resectability rate of malignant fistuke is quite low. Among 31 patients on whom sufficient data is available, only 17 benefited from a resection. A wide variety of procedures were used, depending on the individual situation. A two-stage operation was performed in four cases, consisting initially of a gastrojejunostomy, or an ileotransverse-colostomy,16 or both.8 The secand intervention comprised a right hemicolectomy and excision of the duodenal esion with or without a partial pancreatectomy. In one instance,15 the patient died after the gastrojejunostomy. The surgeons who preferred the one-stage method used a right hemicolectomy with duodenal excision, 1, 2, 5, 7, 10 sometimes combined with a partial gastrectomy. 11, 18 In Fontaine's ase cholecystectomy was also performed. lortat-Jacob's12 procedure included a hemipancreatectomy and transplantation of the mpulla of Vater.

Most authors insist on the need to prepare these patients carefully before submitting them to surgery. It seems desirable

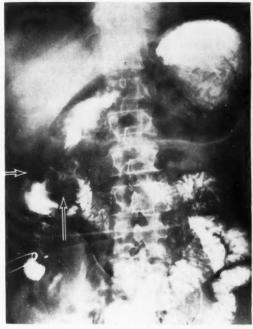


Fig. 3.—Barium meal, September 24, 1958. Duodenocolic fistula. Note good and rapid filling of small bowel.

in most cases to by-pass the fistula as a preliminary operation to restore nutritional balance before resection.

Very little follow-up information is available on the reported cases, but it must be assumed that the survival rate is very low, even in favourable circumstances. The poor prognosis is related to the advanced stage of the neoplastic disease and to the profound and complex deficiencies caused by the fistula.

# SUMMARY

A case of malignant duodenocolic fistula secondary to adenocarcinoma of the hepatic flexure of the colon is reported in detail.

We suspect but cannot prove that the fistula developed simultaneously with obstruction of the colon by the causative lesion. A cæcostomy was performed and the fistula was demonstrated by x-ray examination two months later. The patient died abroad and autopsy was not obtained.

Thirty-eight cases previously published are reviewed. The etiology of the lesion is

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discussed. The clinical picture differs from that of uncomplicated cancer in two respects: the increased severity of the usual symptoms (diarrhœa, weight loss, abdominal pain, vomiting and anæmia) and the occasional presence of two pathognomonic signs, undigested food in the stools and true fæcal eructations or vomiting. Roentgen examination usually establishes the diagnosis, the barium enema being superior to the barium meal.

Hemicolectomy with excision of the duodenal lesion constitutes the treatment of choice, preferably after preliminary procedures to by-pass the fistula.

The prognosis i; poor in any case but possibly related to the nutritional status of the patient and particularly to spread of the primary lesion when detected.

# ACKNOWLEDGMENTS

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#### RÉSUMÉ

Nous rapportons un cas de fistule duodénocolique maligne secondaire à un épithélioma glandulaire de l'angle hépatique du côlon.

Nous croyons, sans pouvoir en faire la preuve, que cette fistule s'est ouverte en même temps que se développait un syndrome d'obstruction au niveau de la lésion primitive. On n'a pu démontrer radiologiquement l'existence de la fistule que deux mois plus tard, alors qu'on avait déjà pratiqué une cæcostomie. Le patient est décédé à l'étranger et nous n'avons pas obtenu l'autopsie.

Nous avons relevé 38 autres cas dans la littérature et présenté un rappel des données étiolo-giques. Le tableau clinique de la fistule maligne diffère de celui du cancer colique simple par la gravité exceptionnelle des symptômes habituels (diarrhée, amaigrissement, douleurs abdominales, vomissements et anémie) et par deux signes pathognomoniques qui se rencontrent parfois: présence d'aliments non-digérés dans les selles et vomisseéructations franchement fécaloïdes ments ou d'emblée. Il faut d'ordinaire recourir à la radiologie pour trancher le diagnostic, et à ce point de vue le lavement baryté donne de meilleurs résultats que le baryum par voie haute.

Le traitement de choix consiste en une hémicolectomie droite avec excision du segment duo-dénal intéressé. Il semble préférable de dériver d'abord le contenu intestinal en excluant la fistule au cours d'une intervention prélimina re.

Le pronostic est sombre en fonction de l'état de dénutrition du patient et surtout de l'envahis ement néoplastique déjà présent au moment du diagnostic.

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# CASE REPORTS

# MALIGNANT DUODENOCOLIC FISTULA – REPORT OF A CASE TREATED SUCCESSFULLY BY MASS RESECTION

ROBERT M. JANES, M.D., F.R.C.S., and J. R. FRANK MILLS, M.D., F.R.C.S. (Edin.), F.A.C.S., F.R.C.S. [C], Toronto

THE AUTHORS were moved to submit the following case report for publication by the article on malignant duodenocolic fistula by Lefebvre and Gardner.† Our task was made easier in that that article has made a review of the literature unnecessary.

Mr. R.L., age 69 years, was admitted to the Toronto General Hospital on October 11, 1955. He had been aware of unusual fatigue for the preceding few months but had attributed this to advancing years and business responsibilities until three months previously when he quite suddenly developed an intractable diarrhoea of 10 or 12 loose movements daily. There was no pain. He had not vomited but those near him had been aware of very bad breath. He had lost 20 to 30 lb. in weight in the three month period and was very tired. He had had several polypi removed from his rectum a few years previously and barium enema at that time had shown a few diverticuli in the sigmoid colon. Apart from this he had always enjoyed robust health,

In spite of loss of weight he still looked pretty well, probably because he had been a heavy man. General clinical examination revealed no abnormality in other systems. The abdomen was flat. There was a deeply placed mass in the right upper quadrant about the size of an orange. It was somewhat irregular in outline, very slightly tender and fixed to the posterior abdominal wall. There was no enlargement of the liver and no abnormal masses could be felt elsewhere in the abdomen. Digital examination of the rectum did not suggest metastases. Roentgenographic examination of the chest was negative. The probable clinical diagnosis seemed to be carcinoma of the colon with invasion of the duodenum and the production of a duodenocolic fistula. When an enema was given, the barium met with some resistance in the region of the hepatic flexure but then flowed freely into the ascending colon and the proximal duodenum and



Fig. 1.—The barium enema filled the colon, the first part of the duodenum, the stomach, and lastly, the transverse duodenum. The fistula is not actually seen but there is a filling defect produced by the tumour.

stomach and more slowly into the transverse duodenum (Fig. 1). A radiological diagnosis of duodenocolic fistula was made and, although no

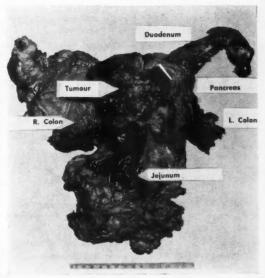


Fig. 2.-The specimen.

<sup>\*904</sup> Medical Arts Building, 170 St. George Street, Toronto 5, Ont.

<sup>†</sup>I EFEBVRE, B. M. AND GARDNER, C. McG.: Malignant duodenocolic fistula, Canad. J. Surg., 3: 86 1959.

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cancer could be shown, a malignant origin was considered most probable. The urine was normal and kidney function was good. The hæmoglobin value was 88%, RBC 4,600,000, WBC 8200 with a colour index of 0.95.

# **OPERATION: OCT. 17, 1955**

The abdomen was opened through a transverse incision. There was a mass four inches or more in diameter in which the hepatic flexure of the colon, the duodenum and the head of the pancreas were involved. A large ulcerating surface could be felt on the posterior wall of the colon with a defect in its centre the size of a finger which obviously represented the fistula. The whole mass was movable on the posterior wall and there was no clinical evidence of metastases to the regional lymph nodes or the liver. It appeared worth while to attempt to remove the whole mass. The resection involved the terminal ileum and ascending colon and the transverse colon to beyond the midline, the whole of the duodenum and a few inches of jejunum, the distal one-third of the stomach, the head and body of the pancreas, the lower end of the common bile duct and the major portion of the greater omentum. The reconstruction presented no unusual difficulty except that since there had been no obstruction to either the common duct or the pancreatic duct both were very small and the anastomosis of these to the jejunum presented a technical problem. The cut end of the pancreas was joined to the side of the bowel with a small plastic tube in the pancreatic duct to ensure patency. A T-tube, the lower end of which extended into the jejunum, was left in the common duct. A single large drainage tube passed to the posterior abdominal wall.

Although the procedure lasted nearly seven hours the patient withstood it well. The postoperative course was uneventful in its early stages apart from a leakage of bile which gradually lessened. He had been out of bed and walking about and was thought ready for discharge when on November 6, 24 days after operation, with-

out previous warning, he developed in extraordinarily acute and extensive left ilio-femoral thrombosis which threatened his life. Two days later he suffered a pelmonary embolus. Recovery from these was slow but he was allowed home on Nove n-ber 30.

So far as the original complaint is concerned he has remained quite well. Some months after operation he complained of symptoms suggestive of œsophagitis and radiological examination disclosed a small sliding hernia as the cause. He developed rather rapidly an œsophageal stricture which required dilatation through the œsophagoscope and subsequently the regular passage of bougies. He has continued to lead a fairly active and useful life. The rather heroic procedure has been amply justified.

## RÉSUMÉ

Ce présentation s'agit d'un homme de 69 ans, admis en octobre 1955 à l'Hôpital général de Toronto, souffrant depuis plusieurs mois de grande fatigue générale, et chez qui était brusquement apparue une diarrhée incoercible. Il avait maigri d'une douzaine de kilogrammes en trois mois. L'examen général ne révélait rien d'anormal, sauf l'existence d'une tuméfaction située en profondeur, grosse comme une orange, dans le quadrant supérieur droit de l'abdomen. Un lavement baryté montre l'existence d'une fistule duodénocolique: le baryum injecté remonte dans le côlon et de là passe directement dans le duodénum et même dans l'estomac.

A l'opération, on retrouve cette tumeur, qui englobe la région hépatique du côlon, le duodénum et le pancréas. On ne voit aucune métastase. Une résection est alors pratiquée, qui comprend l'iléon terminal, le côlon ascendant, le côlon transverse jusqu'à la ligne médiane, la totalité du duodénum avec quelques centimètres de jéjunum, le tiers distal de l'estomac, le pancréas et la partie terminale du cholédoque, ainsi que la majorité du grand épiploon.

Cette intervention fut bien supportée, et malgré un épisode d'embolie pulmonaire, le malade put quitter l'hôpital 48 jours plus tard.

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# EVOLUTION D'UN CAS DE RESECTION INTESTINALE MASSIVE

JEAN COUTURE, M.D., F.R.C.S.[C], GUY NADEAU, D.Sc. et RAYMOND TOURIGNY, M.D., Québec

L'ANS UNE COMMUNICATION antérieure,¹ nous avons rapporté un cas de résection n'assive du petit intestin chez une patiente qui nous avait été envoyée à la suite d'un a cident gynécologique. Le présent travail traite de quelques aspects d'une étude de nutrition faite environ dix-huit mois après l'intervention.

Le premier épisode se résume ainsi. Il s'agit d'une jeune fille de 25 ans admise à l'hôpital S -Sacrement, le 15 octobre 1956, à la suite d'un curettage utérin fait dans une autre institation. Au moment de l'admission, plusieurs a ises intestinales recouvrent la partie interne des cuisses. Après la correction du choc, une prenière intervention procède à l'ablation de plus de 17 pieds (5.1 mètres) de petit intestin, de tout le côlon gauche et de l'utérus (Fig. 1); en même temps une colostomie est faite dans la partie proximale du côlon transverse. Un mois plus tard, nous devons réséquer jusqu'à l'angle hépatique du côlon transverse pour faire une anastomose avec le moignon rectal qui se trouve à trois pouces (7.6 cm.) de l'anus.

A la suite de l'intervention, la patiente perd 12 lb. (5.4 kg.) de poids et présente une diarrhée marquée et fréquente (8 à 12 selles par jour). Un apport quotidien d'eau, d'électrolytes et d'acides aminés permet de prévenir toute modification importante des équilibres aqueux et électrolytiques. La tendance à l'hypochlorémie est facilement corrigée par l'administration de chlorure de sodium. La diarrhée devient moins sévère avec l'ingestion de Kaopectate (kaolin et pectine) et de méthantheline (Banthine) et une diète riche en protéines et en glucides, mais pauvre en graisses.

Nous revoyons la patiente à intervalles réguliers et constatons une amélioration sensible de son état général, bien que son poids ne dépasse pas 90 lb. (40.8 kg.) (poids avant l'intervention: 115 lb. ou 52.1 kg.). L'hypochlorémie mentionnée précédemment s'accompagne d'une légère tendance à l'hypokaliémie, soit 3.5 mEq./l. (normale: 3.8 à 5.2). L'injection de chlorure de potassium corrige facilement le déficit.

Comme nous l'avons déjà mentionné, l'étude métabolique qui fait le sujet du présent travail

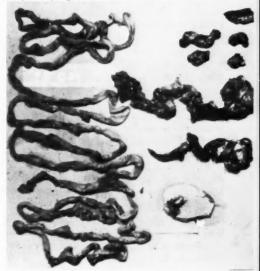


Fig. 1.—Ensemble des tissus prélevés au cours de l'intervention.

fut effectuée dix-huit mois environ après l'épisode initial. Dans ce but, la patiente fut de nouveau hospitalisée et soumise durant quatre jours à une diète rigidement balancée comprenant en moyenne 316 g. de glucides, 110 g. de protéines et 66 g. de lipides par jour. Durant cette période d'observation, toute médication fut interrompue.

# RÉSULTATS

A l'examen clinique, l'état général est bon, bien que le poids soit demeuré stationnaire. Les selles demeurent fréquentes, mais avec l'aide de la méthantheline (Banthine) et d'un choix souvent empirique de ses aliments (rejet des légumes crus et des graisses), la patiente réussit à en restreindre le nombre et semble s'adapter assez bien à son nouveau mode de vie.

Au laboratoire, les bilans acido-basique et électrolytique s'avèrent normaux dans leur ensemble, bien que la tendance à l'hypokaliémie observée antérieurement semble devoir persister (3.7 mEq./l.). Les teneurs en calcium et en phosphore du sang et de l'urine sont normales, mais l'investi-

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gation complète du bilan phospho-calcique est difficile à cause de la proportion des aliments non digérés dans les selles. La valeur moyenne du calcium fécal est de 0.5 g. par jour d'hospitalisation (normale: 0.4 à 0.8 g.). Durant ce temps, la patiente reçoit en moyenne 2.0 g. de calcium alimentaire.

Les fonctions du foie et du rein sont de toute apparence normales (selles normalement pigmentées, absence d'ictère, glycémie, cholestérolémie, lipémie, protéinémie, azotémie, épreuve d'élimination d'urée de Van Slyke normales). L'ionogramme révèle une distribution normale des protéines plasmatiques. On note toutefois un abaissement marqué de l'urée urinaire, soit 5.6 g. en moyenne par 24 heures (normale: 25 à 35 g.).

Les prélèvements de selles faits à l'admission, alors que la patiente prenait de la Banthine, révèlent à l'examen microscopique une digestion alimentaire complète (absence de graisses, de féculents ou de fibres musculaires). Les échantillons individuels sont peu abondants, semi-solides, mais normalement pigmentés. A la suppression de la médication et avec un régime alimentaire connu, les selles deviennent plus fréquentes, demeurent semi-solides, mais leur volume est normal. L'examen microscopique révèle, cette fois, une attaque incomplète des légumineuses. A l'examen microscopique, on trouve dans tous les échantillons des traces de lipides nondigérés, de nombreuses cellules amidonnées et de nombreuses fibres musculaires, Dans les quelques jours qui suivront l'hospitalisation, la patiente reprendra sa médication et un nouvel examen de selles permettra de constater que la digestion alimentaire devient plus adéquate.

# DISCUSSION

Les quelques cas de résection massive du petit intestin, rapportés dans la littérature, signalent peu de perturbations des équilibres acido-basique ou électrolytique, si ce n'est une légère tendance à l'hypokaliémie.<sup>2</sup> Cette observation est en accord avec la nôtre. Par contre, la digestion alimentaire est généralement inadéquate et la stéatorrhée commune.

Les perturbations du métabolisme azc té se manifestent par la présence de nonbreuses fibres musculaires dans les selles, comme l'a signalé Pietz2 chez un mala le ne recevant pas de médication. L'ingesti n de Banthine, chez notre patiente, semble ralentir le transit intestinal de façon suf isante pour compenser le danger d'inabsor >tion alimentaire. Notons, toutefois, qu'en dépit de fonctions hépatique et rénale apparemment normales, l'excrétion urinai e d'urée est constamment demeurée abaissée. On peut en déduire que les protéines et autres sources de produits azotés semble it être en grande partie utilisés à la synthèse endogène et qu'un faible excès seulement est transformé en urée. On sait que les protéines et autres métabolites azotés en excès servent à la formation de l'urée et que l'urée ordinaire, en présence d'une fonction rénale normale, varie proportionnellement à l'absorption des protéines.

Il est vrai qu'avec une diète dépourvue en protéines, mais suffisante en calories, un individu élimine quand mème 4 g. d'urée urinaire par jour (urée endogène). Mais, en pareil cas, on note un amaigrissement peu prononcé, mais progressif, alors qu'avec une diète dépourvue en protéines et insuffisante en calories, l'amaigrissement est beaucoup plus notable. Rappelons que, depuis près de deux ans, notre patiente a un poids stationnaire, en dépit des changements apportés au régime. Cette particularité semble être la règle, à cause de l'absorption calorique insuffisante.<sup>2</sup>

En résumé, l'examen clinique et biochimique, après 18 mois, montre une adaptation satisfaisante malgré la sévérité de l'intervention. La patiente coopérant bien (médication régulière, alimentations sélective) et paraissant se plier de bonne grâce à de nouvelles habitudes hygiéniques, not s croyons pouvoir diminuer la surveillance médicale. A la suite de la présente étud, on pourrait même suggérer, comme set l examen, celui de l'excrétion d'urée ordinaire dans le but d'apprécier l'efficacité de la fonction intestinale vis-à-vis du métabolisme azoté, le seul qui ait subi des modifications importantes.

ADDENDUM

Depuis la rédaction de ce travail, la patiente a gagné 10 lb. (4.5 kg.) de poids.

Les auteurs tiennent à exprimer leur reconna ssance à Mademoiselle Denise Côté à qui était confiée la partie diététique de ce travail.

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#### SUMMARY

desection of 17 feet of small intestine was carried out in a 25 year old woman. At a later intervention an anastomosis with the rectal stump 3 inches from the anus required a further resection of the colon to the hepatic flexure. The patient lost 12 lb. of body weight after the operation and hal loose and frequent bowel movements (from

eight to 12 a day). She was given fluid and electrolyte and amino acid replacements, and the depletion of chloride was easily corrected by administration of salt. Her symptoms were controlled with kaolin, pectine and methantheline bromide (Banthine), together with a diet low in fat and high in protein and carbohydrates. Eighteen months after the original operation, a balance study was made.

The patient showed a tendency to hypokalæmia (3.7 mEq./l.). On an intake of 2 g. calcium per day the fæcal excretion was normal. Liver and kidney function were normal although urinary urea was only 4.6 g./24 hrs. against a normal of 25 to 35 g. While she was on an antispasmodic to reduce the intestinal transit, stool examination was normal; however, when no medication was taken, stools became more frequent, and traces of undigested fat, starch cells and muscle fibres were found on microscopic examination.

The authors suggest that there seems to be a more thorough utilization of dietary proteins in this patient than is normally found. More than two years after her operation, the patient is well and has recently gained 10 lb., which brings her back almost to her original weight.

# MIGRATION LENTE D'UN CORPS ETRANGER ENCLAVE DANS L'ŒSOPHAGE

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IL N'EST PAS très fréquent qu'un corps étranger s'enclave dans l'œsophage sans que l'extraction en soit faite assez tôt après. Ceci toute fois est possible lorsque l'ingestion se produit chez un sujet en état d'ébriété ou encore chez un jeune enfant. Si nous rapportons le cas présent, c'est en se rendant compte que le pronostic des corps étrangers enclavés dans l'œsophage est très sérieux. Nous croyons aussi que ce cas présente quelques leçons dont nous pouvons tous tirer profit.

Les objets les plus fréquemment retirés de l'œsophage sont des pièces de monnaie, des jetons, des os, des aliments, des épingles de sûreté, des prothèses dentaires et des noyaux.¹ Les symptômes auxquels ces corps étrangers donnent naissance ont été souvent décrits. Ils débutent par l'étouffement, le baillonnement, les haut-le-cœur, les vomissements, la douleur, la dyscataposie et la dysphagie. Une hypersalivation se manifeste habituellement. Bientôt apparaissent

des symptômes respiratoires qui, d'après Boyd, seraient présents dans au moins 50% des cas. Une toux sèche apparaît précocement et elle peut s'accompagner d'une respiration sifflante, de dyspnée et même de cyanose. Si le corps étranger demeure enclavé assez longtemps, il peut ulcérer jusque dans trachée ou les bronches avec formation de fistule.<sup>2</sup>

Parmi les complications qui peuvent se produire, mentionnons l'œsophagite, la médiastinite et la cellulite du cou. Ces complications peuvent prendre une allure très grave sous forme d'hémorragie mortelle par pénétration d'un gros vaisseau, de pneumonie, d'abcès, d'empyème ou de gangrène.<sup>7</sup> Il peut se développer un diverticule ou une stricture de l'œsophage. En 1940, 80 cas de perforation de l'aorte par corps étrangers de l'œsophage avaient été rapportés.<sup>8</sup> On en a rapporté plusieurs autres depuis.<sup>5, 6</sup>

La gravité de cette condition est exprimée par Jackson et Jackson<sup>6</sup> qui ont constaté que les porteurs de ces corps

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Fig. 1.

étrangers non extirpés meurent habituellement en moins d'une année.

# HISTOIRE DE CAS

Un petit garçon de trois ans nous est référé le 19 mars 1957 parce qu'une radiographie pulmonaire montrait à la partie supérieure du thorax vers D1 la présence d'un corps étranger (Fig. 1). A cause des symptômes respiratoires, le médecin traitant, présumait que ce corps étranger était logé dans la trachée, mais la mère nous raconte l'histoire suivante.

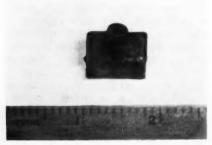


Fig. 2.

Elle n'a jamais eu connaissance que son enf int ait avalé ou aspiré un corps étranger. Elle ne l'a jamais vu s'étouffer non plus. La prem re chose curieuse que la mère nota, environ un an et demi avant son admission à l'hôpital, cest que l'enfant ne voulait plus dormir dans on lit la nuit. Il cherchait plutôt à s'accroupir d ns une chaise pour dormir. A ce moment la mire nota aussi qu'il avait la voix enrouée. L'ent int fit des épisodes grippales avec toux. A l'occas on de ces grippes la mère avait l'impression que la base du cou de l'enfant était enflée. De nombreuses visites furent faites chez le médecin de famille, mais sans amélioration. Environ six nois après le début des symptômes un cliché puli 10naire est tiré. L'image radiologique est identicue à celle que l'on voit dans la Fig. 1. L'im ge opaque à la base du cou évoque celle d'une médaille sainte attachée par un corde autour du cou de l'enfant.

Durant l'année qui suit, c'est le conflit entre les parents et l'enfant qui veut toujours dormir dans sa chaise. On tente par tous les subterfuges de le convaincre de dormir dans un lit comme ses frères et sœurs, mais l'enfant résiste et aime mieux se faire punir que de quitter sa chaise, seul endroit où il peut dormir et respirer convenablement.

Une nouvelle radiographie est prise quelque vingt mois plus tard. L'un de nous (P.L.) cette fois soupçonne la présence d'un corps étranger. L'enfant est alors admis à l'Hôtel-Dieu de Québec. Il présente une toux et des râles, et a tendance à pencher la tête vers la droite. Les infirmières découvrent bientôt son habitude de se reposer en chaise et il s'approprie une petite berceuse de bois qu'il défend jalousement comme a propriété. Il parle peu et sa voix est rauque. Il est dyspnéique à un léger effort et présente un tirage sus-sternal.

Une étude radiologique plus détaillée situe le corps étranger dans l'œsophage. Le 22 mars, une œsophagoscopie-bronchoscopie est pratiquée par l'un de nous (P.P.). Deux escarres anciennes de 1 cm. de long sur 1 cm. de large sont découvertes sur la paroi postérieure le l'hypopharynx. La bouche œsophagienne est normale, mais à 2 cm. plus bas la paroi latéra le gauche présente une légère saillie. La pression du tube œsophagoscopique sur cette saillie poduit une compression de la trachée, qui est notée par l'anesthésiste. Pas d'autre anomalie jusqu'au cardia.

Comme le corps étranger n'a pas été vu, m procède immédiatement à la bronchoscopie. La glotte est normale. La lumière trachéale lu tiers supérieur est déplacée latéralement v rs la droite. Aucune lésion de la muqueuse, m is les grosses bronches sont remplies de sécrétic as mucopurulentes aérées. Il s'agit donc d'une compression extrinsèque latérale gauche, modérée, de la trachée occasionnée par la présence d'un co ps étranger. Il existe un état de bronchite

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Comme de toute évidence il ne sera pas possible d'extraire ce corps étranger par voie en loscopique, il est décidé d'intervenir chirurgi alement. Sous anesthésie générale et intubatic 1 endo-trachéale, une incision est pratiquée le long du bord antérieur du sterno-cléïdom stoïdien gauche. La veine jugulaire interne es isolée. La carotide primitive gauche est très ad rérente à un processus inflammatoire. Pour év ter tout accident nous l'isolons en haut et en bas et l'encerclons avec un bout de cordon. Puis moutieusement elle est isolée sur toute sa longueur. A sa partie moyenne elle est très adhé ente à une masse fibreuse. Au centre de ce te masse fibreuse, immédiatement au-dessous de l'artère, existe une petite dépression au sein de laquelle apparaît un point noir. Le contact metallique montre qu'il s'agit bien du corps étranger en question. L'ouverture dans la masse fibreuse est élargie, le corps étranger pincé et retiré. Quoique nous ne voyons pas de fistule trachéale, il s'échappe des bulles d'air de la profondeur. Les tissus sont refermés sur un lame de caoutchouc. Craignant la possibilité d'une fistule trachéale nous pratiquons immédiatement la trachéotomie avec insertion de canule. Le malade a perdu 35 c.c. de sang.

Les suites post-opératoires sont normales, après quelques jours la canule trachéale est retirée. L'ouverture de la trachéotomie se referme, la toux disparaît. Sans aucune force persuasive, l'enfant abandonne sa chaise et reprend l'usage du lit. Quelques jours plus tard il quitte l'hôpital. La Fig. 2 montre ce corps étranger après son ablation. Revu quelques mois après l'enfant est complètement normal et asymptomatique.

En conclusion, il me semble que nous avons vu se dresser devant nous un tableau clinique assez caractéristique du corps étranger enclavé dans l'œsophage. Malgré ces symptômes cliniques et malgré des radiographies assez révélatrices ce corps étranger demeura en place pendant près de deux ans. Si nous retraçons les évènements chez cet enfant, nous voyons que d'abord il avala ce corps étranger sans que ses parents s'en rendent compte, c'est-à-dire sans signe, du moins au début. Puis par la déglutition répétée, la pièce métallique s'engagea à travers la paroi de l'œsophage pour réussir à en sortir complètement. Les troubles de respiration furent causés par la compression trachéale due à la réaction des

tissus mous au corps étranger. Au moment de l'œsophagoscopie deux escarres demeuraient, seuls témoins de la migration trans-

œsophagienne.

Toute radiographie démontrant un corps étranger devrait nous pousser à une investigation complète. Enfin, il est possible que ce corps étranger, en l'occurrence une petite porte de wagon ou de voiture en fer blanc, à coins pointus, eût avec le temps perforé la trachée ou encore la carotide avec des con équences désastreuses.

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# SUMMARY

The authors report a case of slow migration of an impacted foreign body through the œsophagus in a three year old child. Respiratory symptoms were present for one and a half years before they were considered to be caused by a foreign body. Radiological studies revealed the presence of a metallic shadow which was interpreted as a medal that the child was wearing around his neck. The symptoms present were hoarseness, dyspnœa and cough with frequent respiratory infections. Orthopnoea in this young patient assumed the curious form of refusing to sleep in a bed; the child usually slept in a chair. Œsophagoscopy and bronchoscopy showed the presence of two scars but failed to reselve the child to th but failed to reveal the presence of a foreign body. Surgical exploration of the neck anterior to the left sternomastoid showed a small piece of metal imbedded in scar tissue immediately behind the common carotid artery and adherent to it. This foreign body was easily removed and a tracheotomy was performed because of the possible development of a tracheal fistula. The postoperative course was uneventful. A few months later, the child had resumed normal sleeping habits and was completely asymptomatic. Some of the lessons to be derived from this case are evident. In the light of these facts, it is to be wondered when tracheal or carotid perforation would have occurred.

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# A FOREIGN BODY IN THE APPENDIX A Report of an Unusual Case°

MORRIS H. W. FRIEDMAN, M.D., M.Sc. and WALTER C. MacKENZIE, M.D., C.M., M.S.(Surg.), F.R.C.S.[C], F.A.C.S., Edmonton, Alta.

# HISTORY

THE PRESENCE of foreign bodies in the appendix has been noted for more than 250 years. The earliest probable case, in which a common pin was the offending agent, was described by Ruysch in 1691.1 Further reports appeared during the eighteenth and nineteenth centuries, and foreign bodies became implicated as an important factor in the etiology of acute appendicitis. At one time, the presence of a foreign body was believed to be essential to the development of appendicitis, and fruit seeds, such as orange, date or cherry seeds were frequently described. It is probable that many of these were actually fæcal concretions.2 The present concept is that a true foreign body in the appendix is a rare occurrence. In several thousand cases of acute appendicitis, Ehrlich3 found the incidence of foreign bodies to vary between 0 and 7%.

# ETICLOGY

Objects of an astonishing variety have been located in the appendix, including



Fig. 1.—Plain film of the abdomen demonstrating radio-opaque foreign body below right sacro-iliac joint.



Fig. 2.—Appendix containing metallic foreign body. Slight distension at the tip, and moderate injection of the serosal vessels is apparent.

pins, needles, nails, pebbles, screws, gall-stones, buttons, seeds, shot, pieces of bone, bits of wood, iron filings, beans, oat-hulls, cherry stones, chestnuts, bristles, egg-shell, hair, teeth, globules of solder, worms, fish vertebræ, fins, twigs and straw.<sup>3</sup> Common pins have been found most frequently. Lead shot tends to accumulate in the appendix, and as many as 122 pieces of shot have been found in a single appendix.<sup>1</sup> One of the most unusual foreign bodies found was a germinating seed.<sup>4</sup>

The following report describes the finding of an unusual metallic foreign body in the appendix.

Mr. T.D., a 39 year old Indian trapper, was admitted to the Mewburn Pavilion of the University of Alberta Hospital, on April 4. 1958. He complained of occasional "drag-ting sensations" and recurrent pain in his right loin of several months duration, aggravated v hen walking his trap line, or during active exercise.

Clinical examination revealed a thin, lert adult Indian male. There was no abdominal tenderness or palpable mass. The result of routine laboratory studies and a sigmoidosc pic examination were within normal limits. A plain film of the abdomen (Fig. 1) revealed a met ulic foreign body resembling a .22 calibre rifle b illet lying within the abdominal cavity in the ight lower quadrant. There was some movement

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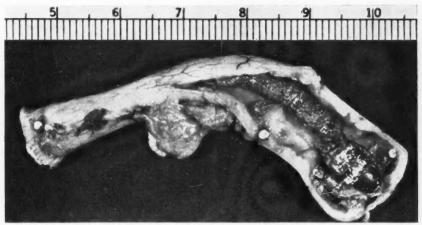


Fig. 3.—Specimen incised longitudinally, revealing rifle slug at distal end, and fæcoliths in the lumen proximally.

of the foreign body with positioning. A barium enema outlined the entire colon with no evidence of abnormality. The appendix was not filled with contrast media.

The patient's history was carefully reviewed. He had never sustained a gun shot wound, had not had an abdominal operation, and had no recollection of eating any game which had been shot with a rifle or other firearm. Nevertheless, it was felt that the foreign body in the abdominal cavity was most likely a rifle slug lying within the appendix.

On April 21, a laparotomy was performed. The appendix was lying in an anterior dependent position. There was moderate injection of the serosal vessels (Fig. 2) but no other evidence of recent or old inflammatory reaction. The metallic foreign body was palpable within the appendix at its distal end. Appendectomy was carried out. The appendix was incised longitudinally (Fig. 3), confirming the presence in the tip of a .22 calibre rifle slug. The foreign body measured 0.9 x 0.5 cm., and weighed 1.9 g. (Fig. 4). Several faecoliths were also present in the appendical lumen proximal to the rifle slug. Histological sections revealed no significant inflammatory changes in the wall of the appendix.

The patient's postoperative course was uneventful, and he was discharged on April 29, 1958.

# PATHO-PHYSIOLOGY

Mitchell<sup>1</sup> records two instances, from personal communications, in which an appendix containing a bullet was removed. No other reports have been found in the

literature. In the present case, the patient undoubtedly swallowed the bullet, which subsequently became trapped in the apdendix. Small, heavy foreign bodies are more likely to settle in the appendix than are lighter objects, not only because of their weight, but also since the mild peristaltic action of the appendix is less effective in their expulsion.

Foreign bodies lodged in the appendix may lie quiescent and asymptomatic for years. More frequently, however, they excite an inflammatory response ranging from an acute gangrenous appendicitis to a mild chronic irritation. Sharp, pointed objects such as pins are the most likely to cause early mucosal erosions, acute inflammation and even perforation.<sup>5</sup> Round smooth objects, such as lead shot or bullets, may



Fig. 4.—Lateral view of .22 calibre rifle slug found in the appendix.

obstruct the appendiceal lumen, cause mild recurrent bouts of pain, and eventually produce an acute inflammation, Small foreign bodies may also act as the nucleus in the formation of an obstruction fæcolith.

# DIAGNOSIS

The diagnosis of a foreign body in the appendix is most often made when the specimen is examined by the surgeon or pathologist. The known ingestion of a small alien body which has not passed through the alimentary tract may lead one to suspect its presence in the appendiceal lumen. A metallic foreign body may be detected roentgenographically before operation.6,7 A simple plain film of the abdomen has been of great value in this regard, supplemented by positioning, fluoroscopy, and the use of contrast media when necessary.

#### CONCLUSIONS

Foreign bodies in the appendix, once believed to be an important factor in the etiology of acute appendicitis, are now considered rare. The ingestion of a foreign body may be unnoticed or forgotten. Symptoms of its presence in the appendix may be mild or severe, and depend upon mucosal injury or obstruction of the lumen. Roentgenographic studies are of value in the preoperative diagnosis. A report is presented of a patient with minimal symptoms in whom a .22 calibre rifle slug was found lodged in the tip of the appendix. Although foreign bodies in the appendix may lie dormant for years, they are always a potential menace, and their removal is justified when they are discovered.

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# RÉSUMÉ

Il y a plus de 250 ans que l'on a signalé la possibilité de rencontrer des corps étrangers dans l'appendice. Ceux-ci peuvent être une invrai-semblable variété d'objets: des épingles, des aiguilles, des clous, des vis, des calculs biliaires, des boutons, des graines, des morceaux d'os ou de bois, des haricots, des noyaux de fruits, des

Coquilles d'œuf etc.

Un cas de ce genre est rapporté ici. Il s'agit d'un Indien de 39 ans, admis en chirurgie pour des sensations douloureuses dans le flanc droit depuis plusieurs mois. A l'examen clinique, l'homme est en bon état général et les épreuves de laboratoire routinières, ainsi que la sigmoïdo-scopie ne montrent rien d'anormal. Cependant un film radiographique de l'abdomen à vide révèle la présence d'un corps étranger dans le quadrant inférieur droit, ressemblant à une balle de pisto-let de calibre .22. Bien que l'anamnèse ait été alors soigneusement refaite à ce point de vue, il appert que le patient n'a jamais eu de blessure par balle. On procède à une laparotomie: l'appendice est facilement extériorisé et il est possible de seutir le corps étranger à la palpation à travers sa paroi, à son extrémité distale. L'appendicectomie est pratiquée et il est alors trouvé dans la lumière une balle de pistolet de calibre .22. L'anatomie patho-logique ne montre pas de lésions inflammatoires sérieuses. Les suites opératoires furent sans histoire. Il est vraisemblable que, dans ce cas, cette balle avait dû être avalée, à l'insu du mala le, avec un morceau de gibier tué au fusil.

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# The Royal College of Physicians and Surgeons of Canada

# NEWSLETTER

A short time ago it was suggested by tle Editorial Board, Canadian Journal of S rgery, that a Royal College of Physic ins and Surgeons of Canada Newsletter centaining items of special interest to surg ons might become a feature of the Cana-

in Journal of Surgery.

Possibly the most interesting current n ws item is the completion of the College office building in Ottawa. The simple but elective limestone facade looks out over pleasant park bordering on the slowflowing Rideau River. In the background Ottawa's impressive new City Hall. standing out against the distant blue of

the Gatineau Hills.

The building was planned to accommodate such future expansion of the College as could be visualized, utilizing a second floor of offices to be rented at present. A board room large enough to allow a full meeting of Council constitutes the central theme of the building. This Council chamber is on the second floor and is approached by a semi-circular staircase, which is effectively highlighted by domed sky-lights. The main floor in the front of the building is made up of the secretary's office, a lounge and the archives room. Behind all this are the main administrative offices of the College.

Of significance to Fellows and other interested people is the news that the Royal College has been designated a charitable educational institution by the federal government; gifts to the College are therefore deductible for federal income taxation purposes and free from federal succession

duties.

On June 1 last, the Governor-General laid the cornerstone of the College in a colourful ceremony attended by the Council, Fellows and visiting dignitaries. At the conclusion of the formal part of the proceedings, tea was served, giving an opportunity for many to see the progress of the building and renew old acquaintances.

The building was ready for occupancy towards the end of August of this year while the first meeting of the Council in the Board Room will take place in January,

This Council meeting will precede the 1960 Annual Meeting, which takes place in Montreal on January 21, 22 and 23. It will be noted that for the first time the Annual Meeting will be three full days instead of the customary two days. This will result in a considerable change in form and procedure, including a new feature of hospital sessions.

Last January, the Council decided that each author presenting a paper at the Annual Meeting in the Division of Surgery should be informed that submission of his

paper to the Canadian Journal of Surgery for consideration by the editorial board, while not mandatory, is highly desirable. One of the very important decisions facing the Council of the College is the

future status of the Certification examination, and still more important, what might be offered to those Certificants in general surgery and internal medicine who have, as yet, no Canadian society to which to

belong.

As a step in the direction of closer cooperation between Fellows and Certificants, and as an indication of the broadening interest of the Royal College in providing additional education opportunities to those engaged in specialist practice, the Council has endorsed the principle of regional meetings. The first of such meetings is to take place in Halifax on October 30 and 31 of this year as a sequel to the Dalhousie University Refresher Course, All the Certificants in the region have been invited not only to attend but to give papers and to take an active part in the discussions. It will be of interest to all to see what takes place at the Atlantic Regional Meet-

Recent Council action is brought to the attention of the Fellows and Certificants concerning the "modified" examination for Certification in General Surgery. The modified examination consisted of an oral and clinical examination only, the written ex-amination being waived on the basis of possession of an F.R.C.S. (England), (Edinburgh) or (Ireland). Council passed a motion which stated that this type of examination is to be abolished except in rare

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instances. This change is to be effective immediately. The reason for this action is the difficulty experienced by the examiners in making a fair decision about the candidate's acceptability on the basis of an oral examination alone.

The Council also has approved a resolution, submitted by the Canadian Orthopædic Association, recommending that the Certification examination in Orthopæcic Surgery be abolished in 1964. This means that thereafter Certification in Orthopæcic Surgery can be obtained only via success at the Fellowship examination in Surgery modified for Orthopædic Surgery.

W. G. BEATTIE, F.R.C.S. [C]. Honorary Assistant Secreta v.

June 30, 1959.

# **Orthopædic Surgery Certification**

To the Editor:

In the past year the Council of the Royal College of Physicians and Surgeons of Canada has continued to review policy with respect to the Certification examinations of the Royal College. Some months ago particular attention was paid to the status of the Certification examination in Orthopædic Surgery, this being stimulated particularly by a communication from the Canadian Orthopædic Society urging that the Royal College give consideration to the discontinuation of the Certification examination in Orthopædic Surgery.

The Council approved a resolution to the effect that the Certification examination in Orthopædic Surgery should be discentinued in the year 1964. In that year, and thereafter, Certification in Orthopæcic Surgery will be granted by the Royal College only on the basis of success at the Fellowship examination in Surgery modified for Orthopædic Surgery. While the Certification examination will be discontinued, the Certificate will still be issued but only to those who are successful at the Fellowship examination.

James H. Graham, F.R.C.P. [C], Secretary,

The Royal College of Physicians and Surgeons of Canada.

150 Metcalfe Street, Ottawa 4, Ont. August 25, 1959.

# DR. ALEXANDER M. AGNEW

It was with deep regret that the Editorial Board of the Canadian Journal of Surgery heard of the death of Dr. Alexander M. Agnew at the age of 59, on August 11, 1959, in Vancouver, B.C. Dr. Agnew was a valued member of the Advisory Board of the Journal. He was nominated by the Society of Obstetricians and Gynæcologists of Canada to represent them on the Board shortly after the inception of the Canadian Journal of Surgery in 1957.

Dr. Agnew was Head of the Department of Obstetrics and Gynæcology of the University of British Columbia's Medical School, a position which he had held since the school was opened in 1950. At that time he was chief of the department of obstetrics and gynæcology at the Vancouver General Hospital.

He served as President of the Vancouver Medical Association (1939-40) and in 1955 was honoured by election as President of the Canadian Society of Obstetricians and Gynæcologists.

CORRIGENDUM

In the article entitled "An Experimental Study of Tendon Suturing Techniques", by R. J. Cowan and A. D. Courtemanche (Canad. J. Surg., 2: 373, 1959) acknowledgment was incorrectly made to the National Research Council. The acknowledgment should read as follows:

"Acknowledgment for assistance is gratefully extended to the Trauma Research Unit, University of British Columbia; to the *Defence Researh Board*, Grant No. DRB 9050-11; and to Johnson & Johnson Ltd."

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# WILLIAM EDWARD GALLIE

It is with deep regret that we announce the death of the doyen of Canadian surgeons, Dr. William Edward Gallie of Toronto. Dr. Gallie died on Friday, September 25, at the age of 77. He was born in Barrie, Ontario, on January 29, 1882 and married Janet Louise Hart on March 3, 1914.

He was educated at the Barrie Collegiate Institute and the University of Toronto, from which he graduated in medicine in 1903. He interned at the Hospital for Sick Children, Toronto and the Toronto General Hospital, moving to an internship in the Hospital for the Ruptured and Crippled, New York, in 1905.

He was appointed a junior surgeon to the Toronto General Hospital in 1908 and held this post until 1912, subsequently becoming Surgeon-in-Chief to the Hospital for Sick Children, Toronto. He became a Fellow of the American College of Surgeons in 1913 and a Fellow of the Royal College of Surgeons of England in 1918.

In 1929 Dr. Gallie succeeded Dr. Starr as Professor of Surgery and Surgeon-in-Chief of the Toronto General Hospital, and by this time his fame was world-wide. He was the first Canadian to be appointed a Hunterian Professor of Surgery at the Royal College of Surgeons of England in 1924, at which time he was introducing his technique for the use of fascia lata as a suture in repair of hernias. He had previously made a name for himself in orthopædic surgery by his work on tendons and on bone grafting.

After his appointment to the chair of surgery, he organized the famous Gallie course for the training of young surgeons, and this subsequently led to the formation of the Gallie Club, whose members were former pupils. His educational activities were further widened when he was appointed Dean of the Faculty of Medicine at Toronto in 1936. His other honours and appointments are too numerous to mention in this short space. The

affection and veneration in which he was held by those who knew him best are the

best tributes to an outstanding Canadian surgeon.

# BOOK REVIEWS

PATHOLOGY OF TUMOURS OF THE NER-VOUS SYSTEM. Dorothy S. Russell, L. J. Rubinstein, and C. E. Lumsden. 318 pp. Illust. Edward Arnold (Publishers) Ltd., London; The Williams and Wilkins Company, Baltimore, Md. 1959, \$13.50.

This companion volume to *Neuropathology* by Greenfield, Blackwood, McMenemey, Meyer and Norman (1958), is welcomed as completing the modern British views in this important field of pathology.

The early chapters of the book are concerned with congenital tumours, meningiomas (with which primary sarcomata of meninges and brain are discussed), tumours of reticular tissue and tumours and hamartomas of blood vessels. In the latter the word "angioma" is unfortunately perpetuated as a term for "vascular malformation". The common hæmangio-endothelioma of the cerebellum is still called "hæmangioblastoma".

The main chapter of the work, on primary temours of neuro-ectodermal origin, accepts fully the view of anaplasia or de-differentiation in the production of gliomata of increasing malignancy, but does not accept the various methods, which have been advocated, of "grading" these tumours. The terms "malignant or anaplastic" astrocytoma and "glioblastoma multiforme" are therefore retained. The medulloblastoma is considered to be essentially a cerebellar tumour. It is described among the gliomata, but its possible neuroblastic origin is discussed. The description of pineal neoplasm is important because of the authority with which the senior author writes.

An interesting discussion of the growth and dissemination of neuro-ectodermal tumours is followed by a chapter on the important subject of deformations of the brain produced by intracranial tumours. A chapter is devoted to secondary (metastatic) tumours.

Tumours of nerve roots and peripheral nerves and peripheral neuronal tumours are well and fully discussed.

Finally, Professor Lumsden adds a chapter on tissue-culture of brain tumours, which is mainly a description of his results of "culturing" 39 tumours of varying histological malignancy in the astrocytoma-glioblastoma group. It will be of interest to see how his interpretation of his observations tallies with that of other workers.

The format of the book is uniform with its companion volume, the illustrations are uniformly

(Continued on page 106)

# CANADIAN JOURNAL OF SURGERY

All communications concerning this Journal should be marked "Canadian Journal of Surgery" and addressed to the Editor, C.M.A. Publications, at C.M.A. House, 150 St. George St., Toronto 5.

The Journal is published quarterly. Subscription is \$10 per year. (It would be greatly appreciated if subscribers would please add bank

ciated if subscribers would please add bank exchange to their cheques.)

# INSTRUCTIONS TO CONTRIBUTORS

# Manuscripts

Manuscripts of original articles, case reports, and other contributions should be forwarded with a covering letter requesting consideration for publication in the Canadian Journal of Surgery. Acceptance is subject to the understanding that they are submitted solely to this Journal, and will not be reprinted without the consent of the author and the publishers. Acceptance or rejection of contributions will be determined by the Editorial Board. As space is available, a limited number of case reports will be published. Articles should be typed on one side only of unruled paper, double-spaced, and with wide margins. Carbon copies cannot be accepted. The author should always retain a carbon copy of material submitted. Every article should contain a summary of the contents. The Concise Oxford Dictionary will be followed for spelling. Dorland's American Medical Dictionary will be followed for scientific terminology. The Editorial Board reserves the right to make the usual editorial changes in manuscripts, including such changes as are necessary to ensure correctness of grammar and spelling, clarification of obscurities or conformity with the style of the Canadian Journal of Surgery. In no case will major changes be made without prior consultation with the author. Authors will receive galley proofs of articles before publication, and are asked to confine alterations of such proofs to a minimum.

# Reprints

Reprints may be ordered on a form which will be supplied with galley proofs. It is important to order these before publication of the article, otherwise an extra charge for additional type-setting will be made.

#### References

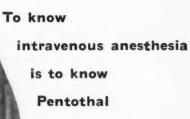
References should be referred to by numerals in the text and should be set out in accordance with the Cumulative Index Medicus abbreviation of journal name and general style. They should include in order: the author's name and initials in capitals; title of the article; abbreviated journal name; volume number, page number and year. References to books should include in order: author's name; title of book; title of publishing house; city of publication; number of edition (e.g., 2nd ed.); year of publication.

#### Illustrations

A reasonable number of black-and-white illustrations will be reproduced free with the articles. Colour work can be published only at the author's expense. Photographs should be glossy prints, unmounted and untrimmed, preferably not larger than 10" x 8". Prints of radiographs are required and not the originals. The magnification of photomicrographs must always be given. Photographs must not be written on or typed on. An identifying legend may be attached to the back. Patients must not be recognizable in illustrations, unless the written consent of the subject for publication has been obtained. Graphs and diagrams should be drawn in India ink on suitable white paper. Lettering should be sufficiently large that after reduction to fit the size of the Journal page it can still be read. Legends to all illustrations should be typed separately from the text and submitted on a separate sheet of paper. Illustrations should not be rolled or folded.

# Language

It should be clearly understood that contributors are at full liberty to submit articles in either English or French, as they please. Acceptance will be quite independent of the language of submission. If the contributor wishes, he may submit an informative summary of not more than 300 words in the language other than that in which he has submitted the article. For example, an article in English must carry an English summary and may, if the author wishes, carry a more detailed summary in French.



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(Continued from page 103)

excellent and the index is adequate. It will be a valuable and comprehensive chart to all who sail the stormy seas of neoplasia of the nervous system.

PERIPHERAL VASCULAR DISEASES. Travis Winsor, University of Southern California School of Medicine. 845 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959. \$18.25.

The number of books which have recently appeared on peripheral vascular diseases is a measure of the increasing interest in and success of therapy. This large volume is comprehensive in its coverage but the discussion of individual problems tends to a terse, almost reportorial style. It is probably the only single publication in which one can find detailed descriptions of the great variety of instruments and tests used in this field, ranging from plethysmography through nail bed microscopy to the care of the artery bank. In many of these tests, careful technique is of paramount importance and it would be well to heed the author's instructions.

One feature is the great profusion of illustrations occupying nearly every page. These black and white drawings, including numerous portraits, give the work a rather startling appearance but they do amplify the text with clarity

There is very little attempt to evaluate he usefulness of the various tests and forms of therapy, which is a pity in view of the auth r's wide experience. Perhaps this is what he intent ed by "an objective approach". This book will not replace others already in the field, particularly when specific advice is sought: however, for quick reference and especially for data on instrumental techniques it is indeed valuable.

BLEEDING ŒSOPHAGEAL VARICES: PC R-TAL HYPERTENSION. Hirsch Robert Lei nowitz, New York University College of Medic ne, with the collaboration of L. M. Rousselet. 186 pp. Illust. Charles C Thomas, Springfield, 1l.; The Ryerson Press, Toronto, 1959. \$27.00.

Rupture of œsophageal varices is the common est cause of death from hæmorrhage from the upper gastrointestinal tract. It is also the most frequent precipitating cause of hepatic coma. For these reasons this comprehensive monograph on bleeding œsophageal varices and portal hypertension is timely.

The author has collected and analyzed the vast and rapidly growing body of literature on the subject. Of particular interest to this reviewer were the sections on the estimation of portal blood pressure, the determination of the site of

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po tal block, hepatic coma, and the treatment of the bleeding varix. The problems of both emerger cy and prophylactic portacaval shunts and the selection of patients for surgery, which are dealt with in detail, are particularly good. Dr. Rousselet, who is well known for his original work in this field, contributed to the sections on surgery.

Because knowledge about portal hypertension is 11 its infancy, time has not sifted that which is 1 ue from that which is false. The book would be improved if the author would sift the conficing evidence for the reader, in short summa ies at the end of each section. This suggestion, however, in no way detracts from the value of he monograph, which should prove to be a source-book of information to those physicians and surgeons responsible for the care of patients with portal hypertension and desophageal varices.

THE CARE OF MINOR HAND INJURIES. Adrian E. Flatt, State University of Iowa, Iowa City. 266 pp. Illust. The C. V. Mosby Co., St. Louis, Mo., 1959, \$9.50.

This excellent monograph opens with a lucid chapter on the relevant anatomy. The remainder of the first section discusses the principles of care and techniques, and closes with a classification of hand injuries.

The author then goes on to discuss specific injuries which can and should be treated in the out-patient department. These are thoroughly and clearly described and, in the main, the advice could not be improved upon. The reviewer does not believe, for instance, that the thenar flap is a good flap, but cannot find any fault with the remainder of the section.

The volume closes with a short discussion of burns of the hand and of infections of the hand.

This well-illustrated book can be thoroughly recommended and will prove of value to the senior student, to the occasional operator, and to the specialist.

PRINCIPLES OF PERIPHERAL VASCULAR SURGERY, S. Thomas Glasser, New York Medical College. 410 pp. Illust. F. A. Davis Company, Philadelphia; The Ryerson Press, Toronto, 1959. \$13.75.

This is a useful reference work including a very comprehensive bibliography covering the more important contributions to within a short time of publication. The first chapter, on the anatomy and physiology of arteries, is perhaps less detailed than might be expected in such a major work; e.g., Poiseuille's law and its applications

(Continued on page 108)



#### A SYSTEM OF ORTHOPAEDICS AND FRACTURES

By A. Graham Apley, M.B., B.S., F.R.C.S., Consultant Orthopaedic Surgeon, the Rowley Bristow Orthopaedic Hospital, Pyford, Surrey, England. Standard Edition \$9.50, Interleaved Edition \$13.50

The logical presentation of each subject makes this volume necessary to all with an interest in orthopaedics and those whose work demands a quick means of reference to the subject. An edition interleaved with blank pages is available for those who wish to add their own notes.

#### MODERN TRENDS IN SURGICAL MATERIALS

Edited by Leon Gillis, M.B.E., M.Ch. (Orth.), F.R.C.S., D.L.O., Consultant Surgeon, Queen Mary's Hospital and St. John's Hospital, London. \$14.50

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are mentioned but the fact that the law pert ins to rigid, medium-sized tubes and not to low through variably expansile and contractile shall minute vessels is examined. Diagnosis of peripheral vascular disease and the various tests i sed are well summarized. Chapters follow on arterial injury and repair, atherosclerosis, thromboans litis obliterans and the management of gangrene und amputations. Sympathectomy is well dealt vith. In the section on functional arterial diseases and syndromes, Raynaud's disease and Rayna id's phenomenon are differentiated and discussed vith the quotation of many useful references. The variation in theories of cause and patholog is emphasized. A somewhat optimistic attitude is taken to the result of sympathectomy for Raynaud's disease of the upper limb. Further chapters include those on venous vascular syndromes of the upper extremities, cold injury syndromes, arteriovenous fistulas, aneurysm, acute arterial occlusion, and blood and lymph vessel tumours.

The venous system is excellently covered with separate chapters on such aspects as thrombosis, phlebitis, varicose veins and lastly the lymphatic system. In these chapters the references are very useful and present a fair picture of the present state of knowledge in these fields.

Illustrations are somewhat sparse throughout but are usually available in the references listed.

#### Books Received

Books are acknowledged as received, but in some cases reviews will also be made in later issues,

Surgery of the Colon, E. S. R. Hughes, The Royal Melbourne Hospital, Melbourne, Australia 416 pp. Illust. E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Company of Canada Limited, Toronto, 1959. \$10.75.

Surgery of the Foot. Henri L, DuVries, Chicago Medical School, Chicago, Ill. 494 pp. Illust. The C. V. Mosby Company, St. Louis, Mo., 1959. \$12.50.

Hernia. Sir Heneage Ogilvie, Guy's Hosı ital London, England. 135 pp. Illust. Edward Ar rold (Publishers) Ltd., London; The Macmillan Company of Canada Limited, Toronto, 1959. \$4,75.

The Pathology and Management of Portal Hypertension. R. Milnes Walker, Universit of Bristol, England. 113 pp. Illust. Edward Annold (Publishers) Ltd., London; The Macmillan Company of Canada Limited, Toronto, 1959. \$6.00.

Worth and Chavasse's Squint: The Bino ular Reflexes and the Treatment of Strabismus, T. J. eith Lyle and G. J. O. Bridgeman. 392 pp. Illust 9th ed. Baillière, Tindall & Cox, London; The Jacmillan Company of Canada Limited, Toronto. 1959. \$8.95.

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#### HISTORY OF CANADIAN SURGERY

#### DR. CLARENCE LESLIE STARR

R. M. JANES, M.D., F.R.C.S., Toronto

CLARENCE LESLIE STARR was born on July 1, 1868, the first anniversary of Confederaion, the beginning of a new era for Canada. The date was significant since half a century nence as the first full-time professor of surgery in the University of Toronto he was o introduce changes which began a new era for the department of surgery. He was to those who did not know him well rather austere and aloof and his somewhat abrupt manner made it difficult for them to approach him. Those who knew him well, however, discovered under this somewhat stern facade an infinitely kindly man whose advice they could seek without hesitation. He was understanding and generous to a degree with his help and quick to express a word of praise for work well done.

The Starrs were of Quaker stock in the Province of Ulster, Ireland. The North American branch of the family was started by Moses and Deborah Starr who sailed from Ireland in 1717 and settled in Chester County, Pennsylvania. Their fifth child, James, came to Canada with his wife Sarah Kinsler and eight children in 1804 and settled in York County near Newmarket, Ontario, where they became members of the local settlement of Quakers. It was here that the tenth child, Hutton, was born in 1807. His son, Milton Hutton, was the first of the family to become a doctor. He graduated from Bellevue Medical School, married Sabra Wilcox of Port Perry and established practice in Georgetown, Ontario. Here he engaged in general practice until 1870 and here his two sons, Frank M. and Clarence Leslie and a daughter, Elma, were born. In 1870 he moved to Brooklin, Ontario, where he continued to practise medicine until he died in November 1920. The daughter married a Baptist minister and this was the church of which Clarence became an adherent. Both sons became doctors. Frank graduated in the United States and spent his life in practice there.



Fig. 1.-Dr. Clarence Leslie Starr.

Clarence married Annie Louise Dryden, eldest daughter of the Hon. John Dryden, Minister of Agriculture in the Ontario Government, in November 1892. They had four daughters. The eldest, Marion, graduated as a nurse from the Hospital for Sick Children and served overseas in the Canadian nursing service in the first world war. All married outside the medical profession. The family background is interesting and no doubt accounts in part at least, for his sterling character, for a certain rigidity which he was wont to display at times and for a simple religious faith which he retained throughout life.

Dr. Clarence Starr received his medical education in the old Toronto School of Medicine and was granted an M.B. by

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t 9th Aacthe University of Toronto in 1890. He therefore must have been a member of the first class to graduate after the university resumed the teaching of medicine in 1887 and absorbed the old Toronto School of Medicine. The first year after graduation he interned in a hospital at Hornell, New York, but most of his postgraduate training was done at Bellevue Hospital, New York, from which institution he received an M.D. After a further year of postgraduate education in Germany and Vienna he returned to New York City where he was for a short time assistant to Dr. Virgil P. Gibney. He came to Toronto in 1893 and began private practice in 1894.

In 1895 he received an appointment as junior surgeon on the staff of the Hospital for Sick Children and was given charge of orthopædic surgery. His first appointment to the staff of the General Hospital appears to have been as registrar in 1899. In October 1902 he became surgeon to the extern department. In 1908, with the reorganization of the department of surgery into services, he became first assistant to Mr. I. H. Cameron. He was attached also to the anatomical department and the years he spent there gave him a first class knowledge of anatomy and led to his insistence that every surgeon must be so equipped. He continued these appointments until 1911 when on reorganization of the staff of the Hospital for Sick Children he became surgeon-in-chief of that hospital. Because of the new ruling that no one could hold dual appointments he gave up his connection with the General Hospital. Dr. W. E. Gallie, who even as a student had become greatly attached to him and had recognized his merit as a teacher, went with him to the Hospital for Sick Children and became his senior assistant. There began the long years of association between these two men which was to be so important in the future of the Toronto school.

He now had for the first time an opportunity to demonstrate his competence in organization and his ability to select young men of promise. The surgical staff had to be rebuilt from the bottom and he had to decide whether to import men trained elsewhere and thus acquire a staff quickly or to slowly surround himself with men whose

development he had followed and fostered from the beginning of their careers. He chose the latter course on the ground that while a few brilliant individuals might bring immediate prestige to the departmen the real success of a surgical staff depended on the development of an esprit de corp: which would withstand the strain of professional rivalry, allow criticism to be given and accepted in a friendly fashion and foster a desire not only for personal ad vancement but for the success of colleagues and the team. He sought in young men a reasonably good student record, a reputation for hard work, a broad education and a desire to add to it, an ability to make and hold friendships, good technical ability and an interest in teaching. Strong individuality was encouraged and the ability to formulate new ideas and produce original work. Every man had to be a gentleman and a person who might conceivably one day head a department. His success in the choice of the staff of the Hospital for Sick Children is now a matter of history. Every single member of the staff he chose made some worthwhile addition to surgical knowledge.

In November 1915 he joined the Canadian Army Medical Corps and after a period of service in Canada proceeded overseas. His great contribution while overseas was as O.C. surgery at the Granville Canadian Special Hospital at Ramsgate where he organized a special service which was regarded as a model of efficiency. After eighteen months overseas he was returned to Canada in October 1917 and was appointed consultant in orthopædic surgery for the Canadian Army. He created in the chain of military hospitals across Canada facilities for the care of the wounded men which were second to none and he devoted all his energies to seeing that every patient received the best possible treatment. The broad principles upon which he planned have been continued over the years. Having completed his task he returned to civilian practice in November 1920 and to his former duties as Surgeon-in-Chief of the Hospital for Sick Children.

It is apparent from the records available that for some years it had been realized by a considerable body of the Faculty

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Council of the Department of Medicine that, the school having grown so large, some change in the administrative set-up was necessary, since heads of major departments could no longer give the time needed by the university and at the same time gain a living from private practice. A generous gift from Sir John and Lady Eaton in 1919 made possible the appointment of Dr. Duncan Graham as the first full-time Professor of Medicine in the British Commonvealth. A grant from the Rockefeller l'oundation in 1921 made possible a similar appointment in surgery and Dr. Starr was chosen to occupy this new chair. The agreement was so drawn that the time the Professor of Surgery could devote to private consultation was restricted to the afternoon hours of four to six. Dr. Starr therefore, in accepting the appointment, was aware that it would entail a very considerable financial sacrifice. In actual fact, the reorganization which he undertook required for some years an almost full-time effort and little time or energy remained for other activities. Unfortunately, it was inevitable that some would be affected adversely by the changes that were brought about and considerable opposition to the principles involved in the new appointments and of the appointee himself developed from this group. This caused him much distress and worry although characteristically, feeling sure that he was right, he carried on without complaint and only those close to him knew the cost. The staunch support which he received from his other colleagues and especially from the younger men was a great source of comfort. This ability to obtain the best that was in younger associates and to command their unswerving loyalty was one of his greatest assets.

Having accomplished what he could by reorganization he proceeded to rebuild the staff of the General Hospital on the same principles that he had employed at the Hospital for Sick Children. The time remaining to him was too short but in the eight years he served as Professor of Surgery and Surgeon-in-Chief of the General Hospital he laid the foundation of the school of surgery in Toronto that has been so productive during the last forty years and

indeed he may justly be called the father of that school. His uncanny judgment of men was demonstrated again in that every man he chose has made a contribution.

As would be expected in the case of one who devoted so much time and thought to organization, he was not a great contributor to surgical literature. He published only eighteen articles, each upon some aspect of orthopædic surgery, which, although he continued to do and maintain an interest in general surgery, was his first love. His most important writing had to do with hæmatogenous osteomyelitis and tuberculous disease of bone, particularly the management of tuberculous abscesses.

He was a Fellow of the American Orthopædic Association. This society was founded in 1887. He was elected to it in 1900 and was president in 1919. He was a Fellow of the American Surgical Association, the American College of Surgeons, the International Surgical Society and a member of the American and Canadian Societies of Clinical Surgeons. He was an Honorary Member of the British Orthopædic Association and the International Surgical Association. He was granted an LL.D. by McMaster University in 1922.

Professor Starr died of coronary thrombosis on Christmas night 1928, after a short illness. He was only 60 years of age. He did not live to see the full flowering of the tree which he had planted. Fortunately he left behind him one who in addition to having great qualities of his own had absorbed through long years of close association and friendship those sound principles of administration and leadership for which Dr. Starr was famed. W. E. Gallie succeeded him as Professor of Surgery in 1929.

In the preparation of this biographical sketch I have received help from many sources but particularly from Dr. W. E. Gallie, Dr. N. S. Shenstone, Professor Starr's eldest daughter, Mrs. Marion Storey, and from the records in the possession of the Dean of Medicine and the Toronto Academy of Medicine.

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#### ORIGINAL ARTICLES

#### LA VALEUR DU MYELOGRAMME

Comme aide diagnostique et pronostique dans les lésions traumatiques du plexus brachial

MAURICE HEON, M.D., F.R.C.S.[C], F.A.C.S. et JEAN SIROIS, M.D., F.A.C.S., Québec

Les blessures par traction de la partie supérieure du plexus brachial sont assez fréquentes pour attirer l'attention de tout médecin et commander une solution judicieuse du problème thérapeutique qu'elles présentent. Si on ne connaît pas leur situation exacte, on risque des thérapeutiques intempestives qui n'apportent que désappointement. Heureusement, certains indices cliniques éclairent parfois le tableau et orientent vers un traitement adéquat. Ainsi, dans une affection de la partie supérieure du plexus brachial, la paralysie du nerf du grand dentelé indique déjà que la lésion siège entre son émergence près de la colonne vertébrale et la moelle épinière elle-même puisque ce nerf provient des premières divisions des racines C5, C6 et C7. De la même façon un syndrome de Claude Bernard-Horner dans un traumatisme du plexus brachial de type inférieur indique une lésion toute proche du canal cervical. Dans ces deux cas cependant, il n'y a aucun moyen clinique permettant de déterminer si les racines ont été arrachées à leur origine dans la moelle épinière ou si la lésion siège en dehors du canal spinal.

Comme l'abord chirurgical est entièrement différent, mème si la distance des segments en question est très courte, tout apport diagnostique doit être utilisé pour arriver à résoudre le problème. Ceci est intimement lié au pronostic de récupération si on accepte avec J. C. White que "lorsque les racines sont arrachées de la moelle épinière, aucune forme de traitement ne peut aider".

Un fait anatomique explique l'utilisation de la myélographie dans ce domaine. Les méninges couvrent la racine nerveuse jusqu'au trou de conjugaison et à ce niveau elles font place au neurilemme. Toute avulsion dans la partie proximale de ce trajet produit une déchirure de l'arachnoïde et la formation ultérieure d'une méningocèle traumatique. C'est le terme qu'employ a Francis Murphy dans un premier article publié à ce sujet en 1947. Cet auteur crut qu'il n'y aurait aucun retour de fonction dans le territoire des racines affectées et recommanda donc la chirurgie réparatrice de la main beaucoup plus hâtivement.

En août 1954, I. M. Tarlov<sup>5</sup> décrivit trois autres cas qu'il soumit à des laminectomies exploratrices confirmant seulement les constatations myélographiques d'avulsion de certaines racines dans le territoire desquelles il n'y eut aucune récupération.

White et Hanelin,<sup>4</sup> la même année, revisèrent le problème après avoir observé un cas similaire. Ils découvrirent ainsi deux autres lésions semblables dont la nature fut établie par le myélogramme.

#### OBSERVATION No 1

Un garçon de 10 ans, fut admis en novembre 1956 après un accident de ferme. L'enfant demeura inconscient pendant trois heures. Quand il s'éveilla, il ne pouvait bouger son bras gauche. Il nota aussi la présence d'une douleur à la région supra-claviculaire du même côté. L'examen révéla une paralysie complète du deltoïde, du triceps, du biceps et du sousépineux. Ce déficit était accompagné d'une anesthésie dans le territoire de C5, C6 et C7. La pression à la région supra-claviculaire provoquait une vive douleur, ce qui compliquait un peu la décision du traitement à instituer. Un myélogramme montra une grande dépression de D8 à D2 à gauche puis la sortie graduelle du lophendylate (Pantopaque) dans l'enveloppe de la racine C6 jusque dans le neurilemme. (Fig. 1 et 2).

La substance opaque continua ainsi à délimiter le tronc supérieur et la partie proximal d'une subdivision du plexus. D'autres dépressions suggéraient également des méningocèles traumatiques aux espaces C4-C5 et C7-D1. Ces constatations orientèrent nettement 12

<sup>\*</sup>Service de Neuro-chirurgie de l'hôpital de l'Enfant-Jésus, Québec.

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Fig. 1.-Cas No 1.

diagnostic vers une avulsion des racines du plexus brachial à leur origine médullaire, et constituèrent une contre-indication chirurgicale. La seule justification d'une intervention aurait été la suggestion d'un hématome épidural dans le canal rachidien mais comme il n'y avait aucun signe de compression médullaire, il fut jugé sage de ne pas conserver ce diagnostic. On dirigea le patient dans un centre de réadaptation. Le patient revint en décembre 1958, deux ans après le traumatisme. On nota alors une atrophie marquée de tout le bras gauche. Le triceps et les extenseurs du poignet étaient complètement paralysés, mais le deltoïde avait repris une certaine fonction et le patient élevait le bras au niveau de son épaule. Le biceps était faible mais conservait quelque usage. Les fléchisseurs des doigts étaient plus forts. On remarqua un certain décollement du bord spinal de l'omoplate. La fonction des interosseux était profondément atteinte. Le tableau était complété par une anesthésie complète dans les dermatomes de C6 et C8 et dans une partie de C7 et par une aréflexie totale dans ce membre.



Fig. 2.-Cas No 1.

#### OBSERVATION No 2

Un garçon âgé de sept ans fut admis un mois après un accident survenu en septembre 1957. Il avait d'abord été traité dans un autre hôpital où il était demeuré inconscient pendant près d'un mois. On nota alors une paralysie complète du bras gauche. L'examen, fait par l'un de nous (J.S.), révéla qu'il y avait déjà à l'admission de très bons mouvements des doigts et du poignet mais une paralysie du deltoïde, du biceps et du triceps avec un déficit sensitif dans le territoire de C6. Le myélogramme con-



Fig. 3.-Cas No 2.



Fig. 4.-Cas No 3.

firma la présence d'une méningocèle à l'origine de la racine C7 gauche. (Fig. 3).

L'amélioration se poursuivit et, deux mois après l'accident, le patient avait récupéré environ 75% des fonctions motrices de ce membre, particulièrement celle du deltoïde, du biceps et du triceps. Il n'a pas été revu depuis, mais des renseignements supplémentaires obtenus par téléphone indiquent que l'enfant peut maintenant se livrer à plusieurs sports violents. Il persisterait encore une minime faiblesse de l'élévation du bras, même si le mouvement est possible dans toute son étendue. En conclusion, la mère du jeune patient insiste sur le fait qu'il demeure très peu ou point de handicap de ce traumatisme.

#### OBSERVATION No 3

Une patiente de 16 ans, est admise à l'hôpital en août 1958 se plaignant de paralysie incomplète et de déficit sensitif dans le bras droit, comme séquelles d'un traumatisme subit lors d'un accident survenu en juin 1958. L'examen révéla un profond déficit moteur et sensitif, dans la distribution de C5, C6, C7, C8 et D1 à droite. A l'exception du deltoïde qui avait conservé une minime fonction, tous les autres muscles étaient complètement paralysés. L'examen des sensibilités révélait un niveau bizarre à ligne de démarcation circulaire. Il n'y avait pas de syndrome de Claude Bernard-Horner, ce qui était une surprise en considérant les résultats de l'investigation subséquente.

On notait aussi l'absence totale de réflexes. Un myélogramme montra une méningocèle traumatique à l'origine de la huitième racine cervicale, ce qui malheureusement n'explique pas tots les symptômes et signes présentés par la malade. (Fig. 4).

#### DISCUSSION

Ces lésions du plexus brachial posent certains problèmes. Le traitement chirurg cal préconisé par Tarlov est-il réellement indiqué? Probablement pas. Tarlov pratqua des laminectomies pour explorer les racines atteintes, mesurer l'étendue des lésions, sans pouvoir accomplir de suture des racines.<sup>5</sup>

Cependant, dans notre premier cas, si un hématome dont la présence était suggérée par le myélogramme avait comprimé la moelle épinière et donné des signes d'atteinte des longs faisceaux, une laminectomie aurait certainement été indiquée.

J. C. White a déclaré que "l'évidence exacte de la présence et de l'étendue d'une avulsion d'une racine spinale peut être



Fig. 5.

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obtenue par myélographie". Cette assertion, demeure discutable puisque dans un cas Tarlov nota encore la présence de fibres radicuaires à l'endroit d'une méningocèle démontrée par nvélographie. Notre cas No tend à prouver que myélographique, étude pien qu'elle aide à formuler un pronostic, ne peut être et n'est pas un moyen complet de déterminer l'irréversibilité de la lésion. D'une certaine façon, cette conclusion pourrait aussi être illustrée par le cas d'une infirmière de 47 ans, admise à l'hôpital en septembre 1956 à cause d'une radiculopathie lombaire avec composante radiculaire, suggérant la possibilité d'une hernie discale. La patiente se plaignait

aussi d'une certaine raideur cervicale accompagnée parfois d'une radiculalgie minime affectant le bras droit, sans déficit moteur ou sensitif. Les réflexes ostéotendineux étaient tous normaux aux membres supérieurs mais le rotulien droit était diminué. Un myélogramme ne révéla rien de spectaculaire dans le canal lombaire, mais à la région cervicale, il montra ce qui était considéré comme une méningocèle traumatique et pourtant il n'y avait absolument aucun déficit objectif décelable à l'examen clinique, dans le territoire de la racine en cause (Fig. 5).

Un autre cas très inusité de traumatisme à la région dorso-lombaire présentait une petite méningocèle ou kyste de la racine L5 sur un myélogramme fait ailleurs. Cet examen fut répété à notre hôpital, trois mois plus tard, et montra que le diverticule avait considérablement augmenté de volume (Fig. 6). Quelques faits cliniques étaient en faveur de la présence d'un déficit objectif partiel dans le territoire de la racine en cause. A l'opération, la racine était en effet non pas divisée mais plutôt comprimée par le kyste.

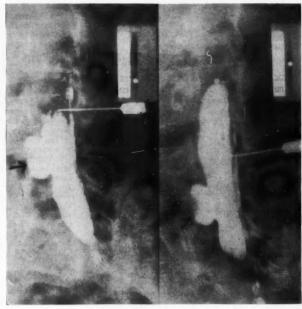


Fig. 6.

Cela suggère seulement que la dure-mère pourrait être déchirée avec son arachnoïde sans qu'il y ait une avulsion complète de la racine elle-même. La clinique seule ne pourrait certes pas résoudre cette question avant plusieurs mois après le traumatisme puisque, selon les observations de Barnes,² dans les lésion dégénératives des racines supérieures du plexus brachial, les premiers signes de récupération peuvent apparaître même jusqu'à 12 mois après la blessure.

Il faut bien souligner que le myélogramme orientera vers l'endroit exact de la lésion et aidera à prévenir des explorations inutiles du plexus brachial dans la région supra-claviculaire. Mais d'autres connaissances sont nécessaires pour déterminer comment une racine ou ses parties peuvent être sauvées quand ses enveloppes dure-mérienne et arachnoïdienne sont déchirées.

#### SOMMAIRE

La valeur du myélogramme dans les cas de traumatisme des racines du plexus brachial est revisée à la lumière de cas cliniques observées dans notre service. Il semble bien que le pronostic de récupération ne soit pas strictement lié à l'aspect myélographique comme on l'avait cru d'abord. Par ailleurs, quand la lésion siège dans le canal rachidien, le traitement chirurgical nous paraît inutile.

Remerciements au Docteur G. Reinhardt qui a permis la présentation du 3e cas dans cet article.

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#### SUMMARY

Traction injuries of the superior part of the brachial plexus are common enough to be encountered by most practitioners, and present both diagnostic and therapeutic problems. Clinical indications sometimes help in diagnosis; for example, if the nerve to the serratus anterior is injured the lesion must lie between the point of emergence of this nerve near the vertebral column and the spinal cord. Similarly, a Horner syndrome in an injury of inferior type indicates a lesion very close to the cervical canal. However, clinical signs do not permit differentiation of root tears within the

spinal cord or outside the spinal canal. Since the surgical approach and the prognosis are entirely different in these two cases, other diagnostic aids such as myelography must be employed. Myelography is useful because the meninges cover the nerveroot in the proximal part of its course, and an injury to this part will tear the arachnoid and cause a traumatic meningocele, visible in the myelogram.

The authors describe three cases of lesions of the brachial plexus in which myelography was helpful. In the first case, an accident produced paralysis of the left arm including deltoid, triceps biceps and infraspinatus, together with anæsthesis in the area of C5, 6 and 7. Myelography showed a severe depression at the level D2 to 8 on the left, together with passage of opaque medium into the sheath of the C6 root. Other depressions suggested the presence of traumatic meningoceles in the C4 to 5 and C7 to D1 spaces. The diagnosis was made of rupture of brachial plexus roots at their spinal cord origin, with contraindication of surgery. The second patient also had a complete paralysis of the left arm but a month later there was good finger and wrist movement with deltoid, biceps and triceps paralysis and sensory deficit in C6. Myelography confirmed the presence of a meningocele at the origin of the C7 root on the left. In the third case the patient had an incomplete paralysis of the right arm and myelography showed a traumatic meningocele at the origin of the 8th cervical root.

The almost complete recovery which occurred in Case two demonstrates that myelography, although it is helpful in estimating prognosis, is not an infallible guide to the reversibility of the lesion. This and other cases suggest that the dura may be torn together with the arachnoid without complete avulsion of the root contained. Myelography will help to locate the exact site of the lesion and may prevent useless explorations of the brachial plexus in the supraclavicular area. However, further knowledge is necessary to determine whether a root or its parts can be saved when the dural and arachnoidal coverings are torn.

### ROENTGEN EVALUATION OF SOFT TISSUES°

"The interpretation of orthopedic roentgenograms is greatly limited in scope if one pays attention only to the bone changes. It is like studying a central figure in an excellent painting without taking into consideration either the background or the setting in which the figure is placed. One without the other should never be attempted: otherwise one fails to gain an appreciation of the whole picture. The background frequently modifies a central figure and

may change its meaning completely so that we must view the entire picture without forgetting any part of it. It is our feeling that the orthopedic surgeon, because of his interest in bones, frequently overlooks the soft tissues which have an immediate relationship to the bone and from which considerable understanding of the bone changes may be obtained. Also, in minimal injuries and early disease, frequently the soft tissue changes are the only positive findings on the roentgenogram. The literature available on soft tissue changes is sparse and for the most part appears in radiologic publications and, therefore, is not widely appreciated in surgical circles."

<sup>\*</sup>Pirkey, E. L. and Hurt, J.: Am. J. Roentgenol., 82: 271, 1959.

#### INTESTINAL REPLACEMENT PROCEDURES\*

B. T. H. MARTEINSSON, M.D. and I. E. MUSGROVE, M.D., Vancouver, B.C.

INTESTINAL transplant or replacement procedures have been performed upon a small series of patients for a variety of lesions of the lower œsophagus and stomach. These transplants have been inserted after three types of excisional operations, as shown in Table I.

TABLE I.—INTESTINAL TRANSPLANT PROCEDURES

I Partial esophagectomy

Jejunal transplant

I Total gastrectomy and partial œsophagectomy

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I I Subtotal gastrectomy

A Right colon transplant B Transverse colon transplant C Jejunal transplant Transverse colon transplant

#### GROUP I: PARTIAL ŒSOPHAGECTOMY AND IEIUNAL TRANSPLANT

Distal œsophagectomy and jejunal transplantation has been carried out on three occasions, the first being for an œsophageal stricture associated with cardiospasm and the remaining two for œsophagitis and ulceration accompanying hiatus hernias.

Case 1.-Fig. 1 is a preoperative x-ray picture of Mr. H.V., who is now 47 years of age. His dysphagia began in 1924. He had had numerous attempts at œsophageal dilatation and in 1953 a Heller operation and pyloroplasty. This operation was not successful and in 1955 a bilateral vagotomy, excision of the distal fourth of œsophagus and jejunal transplantation was performed. Fig. 2. shows the transplant by radiography. He is well today and carrying on as a fisherman.

Case 2.-Mr. R.A., aged 67, had heartburn and indigestion dating back 20 years. Fig. 3 illustrates the degree of œsophageal stricture and shortening that had occurred. He underwent distal cesophagectomy and the jejunal transplant operation in June 1957, and has since done well.

Case 3.-Mr. T. A., aged 40, had a severe hæmatemesis in July 1958. Roentgenograms in August 1958 showed a large ulcer in the oesophagus associated with a hiatus hernia (Fig. 4). Œsophageal resection and jejunal

Fig. 1.—Advanced cardiospasm with distal œsophageal stricture.

transplantation was carried out September 30, 1958, with a good result to date.

DISCUSSION OF **ESOPHAGOJEJUNOGASTROSTOMY** 

The jejunal transplant has two main functions after this operation, the first being to act as a conduit between the resected end of the œsophagus and the normally situated stomach, and the second a substi-

<sup>&</sup>lt;sup>o</sup>Paper presented at the annual meeting of the Royal College of Physicians and Surgeons of Canada, January 1959, Vancouver, B.C.

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Fig. 2.—Jejunal transplant between œsophagus and stomach.

tute sphincter mechanism. It has performed these functions well in these three patients.

Our interest in this operation was stimulated after watching Dr. K. Alvin Merendino of Seattle perform this operation in 1955. Merendino<sup>1-3</sup> has now performed a large series of these operations with a low operative mortality and good long-term follow-up results.

# GROUP II: TOTAL GASTRECTOMY AND PARTIAL ŒSOPHAGECTOMY

#### A. Right Colon Transplant

CASE 4.-Mr. J.R. developed a duodenal ulcer in 1929, when 19 years of age. A gastroenterostomy was carried out in 1932, a vagotomy in 1947, and a partial gastrectomy in 1949. In 1950, he had a severe hæmatemesis from a stomal ulcer. In 1951 he had a ventral hernia repaired and became addicted to barbiturates. On January 31, 1952, the distal œsophagus and total remaining stomach were resected and a right colon transplant was inserted after the method of Hunnicutt,4,5 in which the terminal ileum is transected, with the distal ileal end anastomosed to the œsophagus and the hepatic flexure to the duodenum. Intestinal continuity is then restored by an ileo-transverse colostomy. After a stormy convalescence he returned to work but continued to have bouts of incomplete small bowel obstruction due to adhesions. The ileocæcal value remained competent and he could not vom to the learned to relieve himself by passing a Levine tube into his "new stomach". He became addicted to both narcotics and barbiturates and in May 1954 was found dead in his hotel room. Autopsy was not performed.

This operation has not proved successful in many instances during the past few years and we think it is now of interest mainly from a historical point of view.

#### B. Total Gastrectomy and Partial Œsophagectomy with Jejunal Transplant

There are four cases in this group, two dealing with malignant lesions and two benign peptic ulceration. The latter two cases will be discussed with the final group of patients.

Case 7.-Mrs. F.R.H. began to have dysphagia in July 1955, when 57 years of age. In November 1955, roentgenograms of the œsophagus, stomach, colon and gall-bladder were all reported normal. In May 1956, roentgenograms of the œsophagus and stomach were again reported negative. She was first seen by us in August 1956, at which time she was complaining of epigastric fullness but no true dysphagia. Œsophagoscopy and cytology studies were negative. The patient was not seen again until April 1957, when roentgenograms showed a large gastric cancer. The entire stomach along with the omenta, spleen and distal œsophagus were resected and a jejunal transplant was placed between the œsophagus and duodenum. She made a good recovery and in December 1958 was feeling well. She eats five small meals a day. There has been no evidence of anæmia. Sweets cause a definite dumping syndrome.

Case 8.—Mrs. J.B. first noticed dysphagia in March 1957, when 26 years of age. The dysphagia was definitely worse when she was nervous or upset by her two young children. Roentgenograms in November 1957 were reported to show "cardiospasm". Œsophagoscoj was performed on December 17, 1957, and the findings were consistent with cardiospasm. The distal æsophagus was dilated and cytology smears were taken, which were subsequently reported negative. The dilatation gave very temporary relief and was repeated on February

ary 14, 1958, again with little relief. Radiography was repeated on February 26, 1958, and cardiospasm was again reported. However, with increasing dysphagia and failure of two dilatations, operation was advised. On March 26, 1958, laparotomy disclosed a diffuse carcinoma of the proximal stomach involving the lower resophagus, with no gross evidence of distal pread. Through a thoraco-abdominal incision the distal half of the æsophagus, the stomach, menta, tail of pancreas and spleen were resected and a jejunal transplant was inserted between the æsophagus and duodenum. In December 1958, she had regained her weight and was eating well.

#### DISCUSSION

Œsophagoscopy and cytology studies failed to disclose the carcinoma of the gastric cardia in both these patients. In a patient with dysphagia, exploratory laparotomy is indicated early whenever there is the slightest suspicion of this type of carcinoma.

Nakayama, Professor of Surgery in Chiba, Japan, reports that his predecessor Seo performed jejunal transplantation following total gastrectomy in 1935. In his very extensive experience with total gastrectomy, Nakayama found that jejunal transplantation between the cosophagus and duodenum gave the best functional result.

# GROUP III: SUBTOTAL GASTRECTOMY AND TRANSVERSE COLON TRANSPLANTATION

This is the operation introduced by Mr. James Moroney<sup>7</sup> of Liverpool, in which a segment of transverse colon is interposed between the remaining gastric pouch and the duodenum. This procedure has been performed five times, as shown in Table II.

Four out of five of these patients have developed ulcers in the proximal portion of the colon transplant, the first patient being the only one who has not had radiological evidence of a stomal ulcer.

The last two patients, E.T., and G.A.M., required subsequent total gastrectomies and jejunal transplantation. Mr. G.A.M. died from an anastomotic leak, the only operative death in the entire series.

These patients with recurring ulcer formation should make one think of the Zollinger-Ellison syndrome.<sup>8, 9</sup> In this syn-



Fig. 3.—Œsophageal stricture and shortening associated with hiatus hernia reflux.

drome there is a diagnostic triad of: (1) fulminating ulcer diathesis, especially when the upper jejunum is involved; (2) marked gastric hypersecretion with high free HCl



Fig. 4.—Œsophageal ulceration, accompanying reflux œsophagitis due to a hiatus hernia.

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TABLE II.—PARTIAL GASTRECTOMY AND TRANSPERSE COLON TRANSPLANT

	Age	Sex	Previous operation	Reason for colon transplant	Date
S.M. J.G.M. D.A.D.	45 47 37	M F M	B II B II B II	Post-gastrectomy cripple	Feb. 1953 Feb. 1955 June 1955
E.T. G.A.M.	59 51	F	BII	Recurring ulceration	Feb. 1955 June 1956

values; (3) islet cell tumour of pancreas not producing insulin. We have not encountered a pancreatic lesion in our series to date.

#### Conclusions

 Œsophagojejunogastrostomy appears to be a promising operation for a very difficult surgical problem.

Time alone will reveal the ultimate con-

- 2. After total gastrectomy and particularly when the distal œsophagus is also excised, jejunal transplantation is the operation of choice.
- 3. Transplanted bowel should not be placed distal to the partially resected stomach owing to the almost inevitable ulceration in the transplant.
- The Zollinger-Ellison syndrome should be kept in mind, particularly in recurring ulceration and in ulceration in unusual locations.

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#### RÉSUMÉ

Les auteurs rapportent ici un certain nombre de cas de transplantation de segments du tube

digestif; ces cas ont été groupés en différentes rubriques, selon le type d'opération effectuée. Groupe 1.—Œsophagectomie partielle avec transplantation du jéjunum.—Cette intervention a été faite dans trois cas; il s'agit de trois hommes dont le premier souffrait d'un rétrécissement œsophagien accompagné de spasme du cardia, et les deux autres, d'œsophagite avec ulcération et hé-matémèse. La transplantation du jéjunum a deux fonctions à remplir ici: d'abord assurer la continuité entre la portion terminale de l'œsophage et l'estomac, mais aussi remplacer le sphincter. Dans ces trois cas, cette plastie a donné de très bons résultats.

Groupe 2.--Gastrectomie totale avec œsophagectomie partielle.-Ici deux méthodes ont été essayées: transplantation d'un segment du côlon droit, et transplantation d'un segment de jéjunum. Le premier sous-groupe ne donne que des résultats incertains. Quatre cas appartiennent au second sous-groupe, dont deux étaient porteurs de lésions cancéreuses malignes et les deux autres, de lésions ulcéreuses: les résultats sont, au point de

vue fonctionnel, beaucoup plus satisfaisants ici. Groupe 3.-Gastrectomie subtotale avec trans-plantation d'un segment de côlon transverse.-Dans cette opération, on interpose un segment de côlon entre ce qui reste de l'estomac et le duodénum. Sur cinq des malades que les auteurs ont traités ainsi, quatre ont fait des ulcères au niveau de la partie proximale du segment de côlon transplanté.

#### SURGERY OF THE URETERO-PELVIC JUNCTION

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EVER SINCE we have known the consequences of intrinsic and extrinsic stricture of the uretero-pelvic junction, which are always difficult to evaluate because a catheter can usually be passed, numerous surgical procedures have been described to correct this pathological condition which rogressively brings about the destruction of the kidney by hydronephrosis.

Conservative surgery was practised for many years but failed in most cases before the advent of sulfonamides and antibiotics changed the outcome of these operations; today we can perform them with success and in most cases re-establish normal drainage of the pelvic cavity. Other factors have also contributed to the success of this surgery. They are the development of fine saturing material and atraumatic needles, the improvement in instruments which we owe mostly to plastic surgery, and last but not least the fact that surgery, and particularly urological surgery, has become a disciplined art made up of minute and precise details.

In uretero-pelvic surgery, there are principles to be followed and errors to be

avoided.

#### PRINCIPLES TO BE FOLLOWED

1. Above all, a good exposure is necessary for ease of operation; this can be readily obtained by resection of the 12th rib.

2. It must be kept in mind that the purpose of the operation is to re-establish uretero-pelvic continuity in a funnel shape, so that the anastomosis has to be made at the lowest possible point to allow good and

normal drainage of the pelvis.

3. Uretero-pelvic continuity must be preserved as much as possible, to assure optimum peristaltism. It is therefore necessary to enlarge the diameter of the ureteropelvic junction rather than simply to resect the strictured portion and re-anastomose the ureter to the pelvis.

- 4. Precision is necessary in performing the sections and resections, that is to say, it must always be remembered that the flaps we are cutting or resecting will have to be brought together and sutured in the next operative stage. Hence after having assessed the exact condition we are dealing with, reconstruction has to be carried out with the material at our disposal; thus, we must resect precisely and exactly just what is necessary for the repair, no more and
- 5. The blood supply must be preserved and the uretero-pelvic material never overstripped, because healing would be compromised and fibrosclerosis may sometimes be responsible for a condition worse than the initial one.
- 6. Small and light instruments must be used-short needle-holders well in hand. small pointed forceps and fine suturing material with atraumatic needles. We prefer the 4-0 atraumatic chromic catgut.
- 7. All sutures must be extramucosal, so as to avoid the presence of foreign bodies in the uretero-pelvic lumen, because all of these, even absorbable material, may favour the formation of calcifications which could compromise the final results of the opera-

8. Continuous sutures may sometimes be used, but they have to be longitudinal to avoid creasing the line of suture. The key sutures have to be interrupted and placed near one another to obtain a precise line

of suture that will heal well.

9. It is not always necessary to drain the pelvis if the new uretero-pelvic junction is wide but if this is done, it is better to drain by pyelostomy than by nephrostomy. In fact, pyelostomy drainage has great advantages: (a) sterility of urine is obtained much more rapidly; (b) urinary fistulas of long standing are avoided; (c) trauma to the renal parenchyma is avoided; there is no bleeding and no accumulation of blood clots in the pelvic cavity which could force the sutures and sometimes break them. The pelvis, being free of clot, will drain better. The fact that we want to

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Fig. 1.

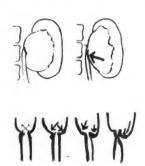


Fig. 2.



Fig. 3.—Foley's procedure.

save the kidney makes it logical to traumatize it as little as possible, because all caliceal or infundibular lesions easily become infected and are slow to heal.

10. It is preferable to use rubber or plastic tubes of Malecot type; they drain better than the de Pezzer type which easily becomes incrusted. If the ureter is observed to have a tendency to kink, a pyelostomy tube prolonged by a mousetail-like mould will serve as a splint to keep the ureter straight during the immediate postoperative period.

11. Sometimes a nephropexy will be indicated to keep the kidney up and the ureter straight, thus avoiding all possible kinks.

12. Before terminating the operation, all sutures must be checked and the tube, if used, also checked for patency; it is preferable to exteriorize the latter by a counterincision, thus avoiding inflammatory reaction in the wound, infection and fistulas slow to heal.

#### ERRORS TO BE AVOIDED

1. All angular anastomoses which are not in the lowest portion of the pelvis.

2. All longitudinal incision of the stricture followed by transverse suture, because this procedure corrects only the anterior portion of the stricture, and gives the results illustrated in Fig. 1.

3. All anastomoses in which redundancy of the pelvic pouch might cause pressure on the new uretero-pelvic junction; otherwise, after operation, the new anastomosis will resemble an abnormal implantation of the ureter high in the pelvis, as illustrated in Fig. 2.

4. All drainage by nephrostomy which traumatizes the parenchyma, and favours the formation of blood clots which are a factor in infection, and so endanger the final results.

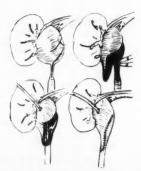


Fig. 4.-Culp's procedure.

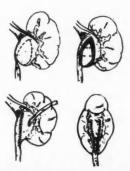
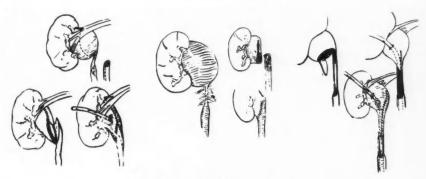


Fig. 5.-Bischoff's procedure.



Figs. 6, 7 and 8.-Other procedures.

#### TECHNIQUES TO BE UTILIZED

Personally we think that three procedures cover practically all the possibilities, as long as they are modified if necessary to adapt them to the lesion actually being treated in the particular case.

We use the *Foley technique* for high implantation of the ureter in the pelvis and for short strictures of the uretero-pelvic junction not over 1 to 1.5 cm. long (Fig. 3), but we prefer *Culp's technique* for the large pelvis and for strictures with a length of

3, 4 or even 5 cm. With this excellent procedure, it is always possible to create a funnel-shaped pyelo-ureteral junction (Fig. 4).

The third technique we use is *Bischoff's* which we recommend in cases of large hydronephrosis, because with this procedure (illustrated in Fig. 5) we resect the stricture and the hydronephrotic pouch widely and also preserve the continuity of the pelvis and the ureter.

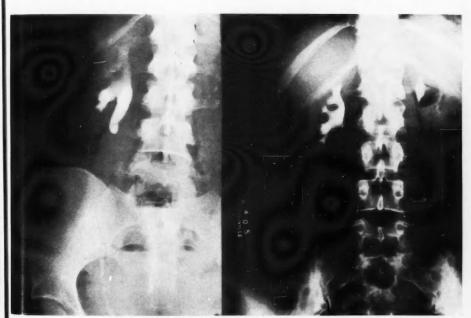


Fig. 9a.-Results obtained with Culp's procedure.

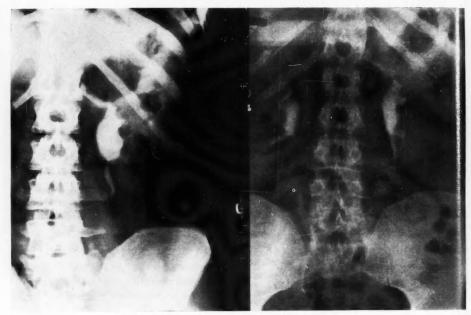


Fig. 9b.-Results obtained with Culp's procedure.

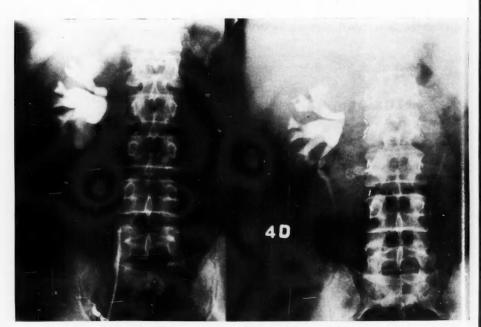


Fig. 9c.-Results obtained with Culp's procedure.

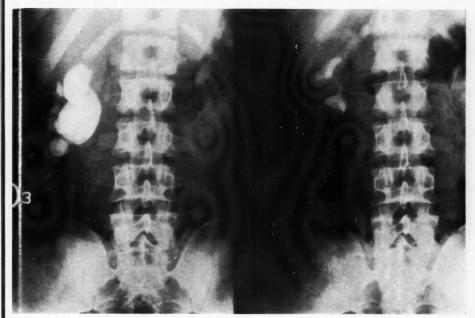


Fig. 9d.—Results obtained with Culp's procedure.



Fig. 9e.-Results obtained with Culp's procedure.

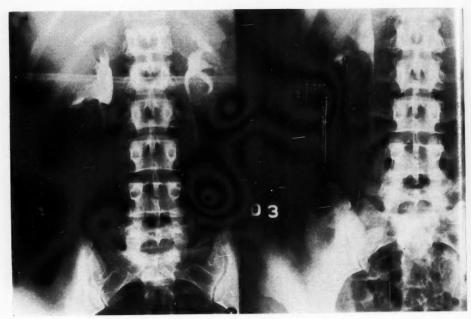


Fig. 10a.-Results obtained with Foley's procedure.



Fig. 10b.-Results obtained with Foley's procedure.

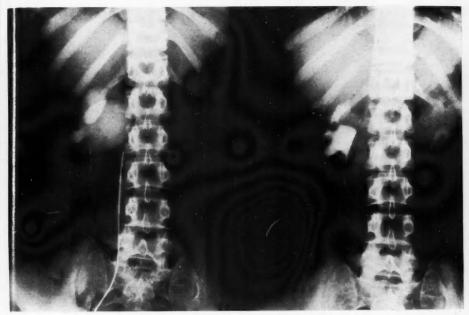


Fig. 10c.-Results obtained with Foley's procedure.

We have obtained our best results with these three techniques.

In other cases, a *simple resection of the uretero-pelvic junction* has been necessary, but it always has to be made elliptically, so as to preserve a sufficient calibre of the anastomosis, as shown in Figs. 6 and 7.

Finally, in cases where the stricture of the ureter is very long and the pelvic material insufficient to assist in the repair, we can use the *Davis-Foley procedure*, which may give subjective relief but to our knowledge has never led to the complete restitution that we can hope for with the other procedures.

#### POSTOPERATIVE TREATMENT

In this type of surgery, postoperative treatment is as important as the operation itself, because a lack of attention may ruin everything; excellent nursing collaboration is therefore essential for good results of these operations.

1. Care must be taken that the tube is never obstructed. It is advisable during the first 24 hours to irrigate this tube frequently to remove all small blood clots that might create an obstruction and provoke an intrapelvic hæmorrhage; after irrigation, we advise instillation of 3 to 5 c.c. of a 1% neomycin solution, so as to reduce infection to its lowest point.

2. The tube must never be allowed to kink; it is thus important to do a post-operative dressing.

3. Urinary output must never be allowed to fall below 1500 c.c. and it is much better to keep it around 2000 c.c.; this will prevent the formation of incrustations, will permit better drainage and diminish the possibilities of infection that might compromise the whole result.

4. As much as possible, the urine must be kept at an acid pH to avoid all calcific precipitation. This pH can be obtained with ammonium chloride, methenamine mandelate or any other urinary antiseptic which is also an acidifier.

5. Antibiotics should be prescribed as a routine and given for as long as the patient is intubated.

6. The drainage tube should be removed around the eighth or 10th postoperative day, because after this period it is of no use.

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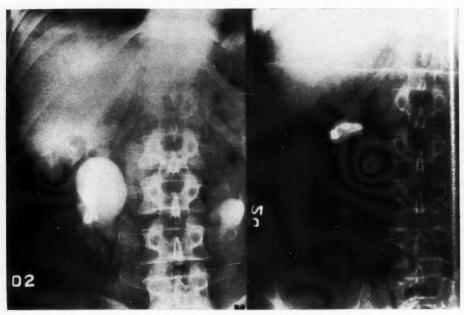


Fig. 11a.-Results obtained with Gibson-Bischoff procedure.

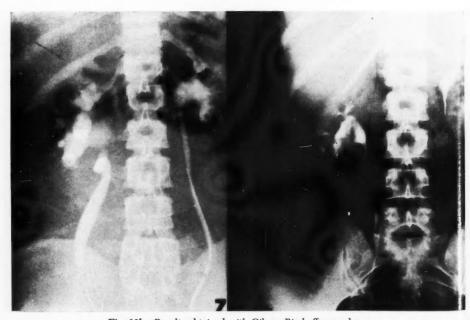


Fig. 11b.—Results obtained with Gibson-Bischoff procedure.

#### RESULTS

Here (Figs. 9 a-e, 10 a-c and 11 a and b) is a series of cases in which the principles reviously laid down have been scrupulusly followed; they offer proof that surfical discipline, made up of minute and recise details, can in the majority of cases give us a restitution ad integrum or very rear it.

We have had failures also, but we have to admit that practically every time they lappened we had missed a detail or made a technical error.

#### Conclusions

We sincerely think and honestly say that if the very precise rules of plastic repair surgery of the uretero-pelvic junction are well observed, we can hope for very good results dependent on a severe operative discipline, minutely and precisely executed as dictated by love of conscientious surgery.

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#### RÉSUMÉ

La chirurgie qui se propose de rétablir une fonction normale au niveau de la jonction uretèrebassinet, pour diverses affections, est difficile et ses résultats sont souvent inconstants. Cet article expose un certain nombre de principes à suivre, et d'erreurs à éviter.

Il faut d'abord avoir une très bonne vue sur la région opératoire; ceci est grandement facilité par la résection de la dernière côte; 2—le chirurgien devra toujours tendre à reconstituer la forme normale "en entonnoir" des structures; c'est le meilleur moyen d'obtenir un drainage efficace; 3—une continuité parfaite entre le bassinet et l'uretère doit être assurée; 4—les résections de strictures doivent être faites aussi économiquement que possible et avec précision; 5—les dissections trop poussées du bassinet et de l'uretère peuvent être dangereuses car elles entraînent des ischémies; 6—les instruments et le matériel de suture doivent être très fins; 7—toutes les sutures doivent être extranuqueuses; 8—les surjets sont à déconseiller; 9—il n'est pas toujours nécessaire de drainer, mais si on y est forcé, il vaut mieux le faire par pyélostomie plutôt que par néphrostomie; 10—il est conseillé d'employer des drains Malecot en matière plastique ou en caoutchouc; 11—il faudra penser à associer à ces reconstructions une néphropexie, si elle est indiquée.

Le traitement post-opératoire est aussi de la plus haute importance. Il faudra veiller à empêcher toute obstruction du tube de drainage, ou toute plicature de ce même tube. L'excrétion urinaire doit être maintenue à une quantité minimum de 2000 c.c. pour éviter la formation de précipités. Il est bon, autant que possible, de maintenir les urines à un pH acide, dans le même but. Les antibiotiques seront administrés systématiquement. Enfin, le tube de drainage ne devra pas être laissé plus de 8 à 10 jours, car, après cette période, il ne sert plus à rien.

PERI-URETERIC FIBROSIS®

In this condition a diffuse mat of fibrous tissue develops in the retroperitoneal space immediately in front of the posterior abdominal wall. Although the term "peri-ureteric fibrosis" has been commonly used, the area of fibrous tissue involves also the great vessels and may, in fact, produce vascular symptoms quite apart

from ureteric obstruction. Ureteric involvement has, however, occurred more frequently than vascular obstruction and has been more dramatic in its manifestations.

The cause of the disease is unknown and the fibrous tissue when sectioned shows no especial features. On the other hand the effects are serious and may well be fatal if a correct diagnosis is not made. It seems likely that the disease has been overlooked in the past and may have been responsible for a number of deaths.

<sup>&</sup>lt;sup>o</sup>Ross, J. C. and Tinckler, L. F.: Renal failure due to peri-ureteric fibrosis, *Brit. J. Surg.*, **46**: 58, 1958.

# THE ACID-BASE STATUS OF DONOR BLOOD AS USED FOR EXTRACORPOREAL CIRCULATION°

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Many reports have been published concerning changes in acid-base balance before, during and after perfusion of both experimental animals and humans.<sup>3, 4, 6-8, 10, 12, 13</sup> However, there are few references<sup>14</sup> to the status of the donor blood used for extracorporeal circulation. This is particularly true of the effects of blood collection, storage, filming and recirculation in a stationary, vertical screen oxygenator.

Included in the biochemical determinations made during operations involving cardiopulmonary bypass at The Montreal Children's Hospital were studies of blood samples drawn from the oxygenator before and after filming. Changes in the method of filming and in the duration of donor blood storage were made during the period covered by this report; these changes produced alterations in the acid-base status of the donor blood.

#### METHOD AND MATERIAL

Blood samples for acid-base determinations were obtained in 53 of 73 consecutive operations using extracorporeal circulation. All determinations made on the donor blood before circulation through the patient are contained in this report.

Blood for priming the pump-oxygenator was collected by gravity into plastic bags.‡ In the first 30 operations the bags contained 30 ml. of 0.9% saline with 18 mg. heparin and 0.5 g. of glucose. In subsequent operations the bags contained 20 mg. of heparin in 30 ml. of saline and no glucose. When the blood was drawn on the morning of operation, the blood containers were transferred

to a constant temperature bath maintain d at 39° C., until required two to four hours later. After operation No. 30, we began of collect blood on the afternoon preceding operation; this blood was stored overnight at 4° C., and was placed in the warming bath for 30 to 45 minutes before use.

The pump-oxygenator was filled with approximately 2500 ml. of blood by means of standard transfusion sets connected to the plastic bags. A sample of this pooled donor blood in the apparatus was immediately taken. A film of blood was then produced on each side of each screen in the artificial lung. At first this necessitated some dilution of the blood by saline since the oxygenator was filled with saline until immediately before filming; this was later avoided by the addition of a mechanical filmer which could be drawn over the screens to produce the film. When the film had been formed, the blood was recirculated through the apparatus while either 100% O2 or 97% O2 with 3% CO2 was passed through the lung. After about five minutes recirculation a second sample was drawn from the now fully oxygenated pooled donor blood.

All samples were collected under anaerobic conditions in heparinized siliconized syringes. Determinations of blood pH, serum pCO<sub>2</sub> and bicarbonate were made with an Astrup apparatus.<sup>1, 2</sup>

#### RESULTS

The operations have been grouped as follows:

*Group I.*—Fourteen operations are included in this group.

The CO<sub>2</sub> tension was reduced to a lovelevel by passing 100% O<sub>2</sub> over the screens during recirculation on 10 occasions, and by allowing the donor blood to equilibrate with room air in the remaining four. The data are shown in Table I. In 12 instances the blood was collected on the day of operation and saline dilution occurred during filming; twice the blood was collected

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<sup>†</sup>Department of Surgical Research, Johns Hopkins Hospital, Baltimore, Md. (Travelling Fellow of the R. Samuel McLaughlin Foundation.)

<sup>‡</sup>Abbott Laboratories Limited, Montreal.

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TABLE I.

Patient	Poc	oled donor bl	ood	Saline		A	fter oxygena	tion
No.	pH	$pCO_2$	$HCO_3$	filming	Gas used	pH	$pCO_2$	$HCO_3$
4	7.22	60.0	22.0	Yes	100%*	7.59	12.0	13.5
5	7.23	50.0	21.0	Yes	100%	7.47	17.5	14.3
6	7.18	56.0	19.0	Yes	Air	7.36	21.0	12.5
7	7.21	49.5	18.0	Yes	Air	7.28	25.2	12.2
8				Yes	100%	7.24	27.5	11.9
9	7.14	59.0	18.0	Yes	100%	7.47	13.5	8.5
10	7.16	54.5	17.5	Yes	100%	7.25	26.8	12.0
11	7.21	40.5	15.5	Yes	100%	7.46	14.0	11.2
12	7.21	49.0	18.0	Yes	100%	7.60	5.0	8.5
13	7.20	45.0	16.5	Yes	100%	7.28	22.0	11.0
16	7.25	58.0	22.0	Yes	Air	7.27	24.5	11.7
17	7.16	44.0	14.7	Yes	Air	7.24	19.5	9.5
62	7.23	46.0	18.0	No	100%	7.36	26.0	15.0
73	7.23	46.0	18.0	No	100%	7.34	25.0	18.0
Average:	7.20	50.6	18.3			7.37	20.0	12.1

 $<sup>\</sup>begin{array}{ccc} *100\% \ {\rm oxygen} \ {\rm passed} \ {\rm through} \ {\rm oxygenator}. \\ {\rm pCO_2 \ in} \ {\rm mm.} \ {\rm Hg} & {\rm HCO_3 \ in} \ {\rm mEq./l.} \end{array}$ 

TABLE II.—SERIES A.

Patient	Pod	oled donor bl	ood	Saline		Af	ter oxygenati	on
No.	pH	$pCO_2$	$HCO_3$	filming	Gas used	pH	$pCO_2$	HCO
14	7.23	39.0	15.5	Yes	97%*	7.29	320	15.0
15	7.19	50.0	17.5	66	44	7.34	16.0	10.0
18	7.21	43.0	16.0	6.6	66	7.26	31.5	14.0
19	7.21	42.5	15.8	66	4.6	7.21	23.4	9.8
20	7.23	44.0	17.5	6.6	66	7.30	24.5	12.5
21	7.15	57.0	18.0	66	44	7.28	19.0	10.0
22	7.19	35.0	13.0	44	4.6	7.28	22.0	11.0
23	7.19	40.0	17.5	44	66	7.34	24.0	13.4
24	7.36	43.0	23.4	66	6.6	7.44	22.0	15.5
	7.25	$43.0 \\ 42.0$	18.0	66	66	7.32	24.0	13.0
25			$\frac{18.0}{22.0}$	66	66		32.0	17.0
26	7.30	48.0		66	44	7.34		
27	7.23	58.0	22.0	66	44	7.24	30.0	13.0
28	7.21	48.0	18.0	46	44	7.26	29.0	13.0
29	7.25	50.0	20.0	66	66	7.30	31.0	15.0
30	7.22	48.0	18.5	6.6	6.6	7.28	27.0	13.0
Average:	7.23	45.8	18.2			7.30	25.8	13.0
			8	Series B.				
46	7.34	43.0	23.0	No	66	7.42	27.0	17.5
47	7.36	42.0	23.5	44	6.6	7.60	19.6	20.0
48	7.34	40.6	21.0	6.6	4.6	7.35	34.0	18.0
49	7.35	40.0	21.0	6.6	44	7.35	32.0	17.5
50	7.27	50.0	21.0	6.6	66	7.30	38.0	18.0
51	7.27	41.5	18.5	66	66	7.28	36.0	16.0
52	7.27	46.0	19.5	6.6	66	7.28	38.0	17.0
53	7.25	50.0	20.0	6.6	66	7.31	30.0	15.0
54	7.28	40.0	18.0	66	66	7.28	38.0	17.0
55	7.24	54.0	21.0	66	66	7.28	37.0	17.0
56	7.29	52.0	23.0	6.6	66	7.32	43.0	20.5
57	7.28	44.0	19.0	66	64	7.32	38.0	18.5
	7.33		21.0	66	66	7.29	41.0	
58	7.33	42.0		66	66	7.30		19.0
59	7.30	42.0	19.5	66	66		36.0	17.0
60	7.31	47.0	21.5	66	66	7.31	40.0	19.0
61	7.25	56.0	22.0	66	44	7.23	54.0	20.5
64	7.30	48.0	22.0	66	66	7.28	42.0	19.0
65	7.24	60.0	23.0			7.29	44.0	19.5
†66	6.98	85.0	17.0	66	66	7.0	56.0	12.0
67	7.20	62.0	21.5	66	66	7.21	52.0	19.0
69	7.25	38.0	16.0	66	"	7.30	34.0	16.0
70	7.23	52.0	19.5	66	44	7.28	35.0	16.0
71	7.21	52.0	19.0	4.6	46	7.18	39.0	14.0
72	7.25	48.0	19.5	64	66	7.28	38.0	17.0
Average:	7.28	47.4	20.6			7.31	37.6	17.7

<sup>\*97%</sup> oxygen—3% carbon dioxide passed through oxygenator. †Prolonged warming of donor blood. Omitted from average.

TABLE III.—POOLED DONOR BLOOD

Patient	Draw	n day of ope		Patient	Drawn	day before o	
No.	pH	$pCO_2$	$HCO_3$	No.	pH	$pCO_2$	HCC
4	7.22	60.0	22.0	46	7.34	43.0	23.0
5	7.23	50.0	21.0	47	7.36	42.0	23.
6	7.18	56.0	19:0	48	7.34	40.6	21.0
7	7.21	49.5	18.0	49	7.35	40.0	21.0
8				50	7.27	50.0	21.0
9	7.14	59.0	18.0	51	7.27	41.5	18.
10	7.16	54.5	17.5	52	7.27	46.0	19.
11	7.21	40.5	15.5	53	7.25	50.0	20.
12	7.21	49.0	18.0	54	7.28	40.0	18.0
13	7.20	45.0	16.5	55	7.24	54.0	21.
14	7.23	39.0	15.5	56	7.29	52.0	23.
15	7.19	50.0	17.5	57	7.28	44.0	19.
16	7.25	58.0	22.0	58	7.33	42.0	21.
17	7.16	44.0	19.7	59	7.30	42.0	19.
18	7.21	43.0	16.0	60	7.31	47.0	21.
19	7.21	42.5	15.8	61	7.25	56.0	22.
20	7.23	44.0	17.5	62	7.23	46.0	18.
21	7.15	57.0	18.0	64	7.30	48.0	22.
22	7.19	35.0	13.0	65	7.24	60.0	23.
23	7.27	40.0	17.5	66*	6.98	85.0	17.
24	7.36	43.0	23.4	67	7.20	62.0	21.
25	7.25	42.0	18.0	69	7.25	38.0	16.
26	7.30	48.0	22.0	70	7.23	52.0	19.
27	7.23	58.0	22.0	71	7.21	52.0	19.
28	7.21	48.0	18.0	72	7.25	48.0	19.
29	7.25	50.0	20.0	73	7.23	46.8	18.
30	7.22	48.0	18.5				
Average:	7.22	48.1	18.5		7.27	47.3	20.

\*Prolonged warming. Omitted from average.

on the day before operation and no saline was used. The bicarbonate level dropped to 12.1 mEq./l. after oxygenation, partly owing to the low carbon dioxide tension produced by the 100% oxygen passed over the screens and partly owing to dilution by saline.

Group II.—A gas mixture of 97% O<sub>2</sub> and 3% CO<sub>2</sub> was used in 39 other operations (Table II). In 15 (Series A) the blood was collected on the morning of operation and saline dilution occurred. In 24 (Series B) the blood was collected on the day before operation and no saline was used. The post-oxygenation bicarbonate level rose in Series B to a more satisfactory level as compared with Series A, owing to the avoidance of the use of saline made possible by adding a mechanical filmer.

Group III.—The pooled donor blood samples were grouped in Table III in order to compare blood drawn on the morning of operation and kept at body temperature with that refrigerated overnight. These samples had not been through the oxygenator, so that neither the gas used nor the method of filming is pertinent. The blood

stored overnight was less acidotic than that drawn on the morning of operation.

#### DISCUSSION

The desirability of eliminating saline from the filming process is obvious since the deleterious effects of excess salt on patients with cardiac disease are well known. Clearly, the less dilution and the closer to normal the chemical composition of the blood the better. Our results show a marked drop in bicarbonate level when saline was used. However, because of simultaneous alterations in the gas mixture and the duration of storage, little can be done to assess the relative importance of the saline.

Blood collected on the day preceding operation, refrigerated and then warmed for 30 to 45 minutes is less acidotic than that obtained on the morning of operation and maintained at body temperature for several hours. That cellular metabolism continues in stored blood is well recognized, in the metabolic rate varying with blood temperature. This is well illustrated by operation No. 66, in which an unusual extracardia:

anomaly was discovered after the blood had been placed in the warming bath and typass was delayed several hours. Here the rCO, rose to 85 mm. Hg, and the pH fell t) 6.98. There is no reason why blood drawn on the morning of operation should not be refrigerated until shortly before use. Although blood refrigerated overnight may be as satisfactory biochemically as that drawn on the day of operation, there must be 5)me deterioration in the cellular elements.5

An oxygen and carbon dioxide mixture keeps the carbon dioxide tension in the normal range and prevents the marked drop in bicarbonate level that occurs with the hypocaphæa produced by using 100% oxygen.6 The role of the low bicarbonate concentration in the production of postoperative acidosis has been described previously.7 It has been suggested by several authors that the high oxygen tension produced in the blood by the use of gases high in oxygen saturation is undesirable.9 This statement remains unproved. Clark<sup>3</sup> has shown that arterial oxygen tensions in the range of 400-600 mm. Hg are well tolerated both experimentally and clinically.

#### SUMMARY

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This report details observations on the acid-base status of donor blood used for extracorporeal circulation. Our results indicate the advantages of refrigerating blood until shortly before operation and using a 97% O<sub>2</sub> and 3% CO<sub>2</sub> gas mixture during recirculation.

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#### RÉSUMÉ

De très nombreux travaux ont été consacrés aux modifications du sang et de l'équilibre acidobasique au cours, avant et après les transfusions, tant chez l'homme que chez les animaux. Cepen-dant peu de chose a été fait en ce qui concerne l'état du sang qui doit être administré. On a plus particulièrement étudié ici les modifications apportées au sang lors de son passage dans l'oxygénateur. Pour ce faire, des échantillons de sang furent prélevés au cours de 53 interventions faisant appel à une circulation extracorporelle, en vue d'y dé-terminer l'état d'équilibre acidobasique. Diverses modifications furent apportées au passage du sang dans l'oxygénateur, et dans l'ensemble les résultats de ces expériences peuvent être résumés comme suit: 1) il est hautement désirable d'éviter toute dilution du sang par des solutions salines, car elles provoquent une chute des bicarbonates (ceci se comprend lorsqu'on pense que moins le sang sera dilué, plus il aura une composition proche de la normale); 2) le sang recueilli la veille de l'opé-ration, conservé au réfrigérateur et ensuite ré-chauffé pendant 30 à 45 minutes se montre moins acidosique que celui obtenu immédiatement avant l'intervention et conservé à la température du corps; et, 3) l'utilisation d'un mélange CO<sup>2</sup>/O<sup>2</sup> permet de maintenir la tension de CO2 proche de la normale et évite la chute marquée du taux des bicarbonates que l'on observe avec l'emploi d'oxy-gène pur. L'ensemble des données de laboratoire est fourni sous forme de tableaux.

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# ILEOCYSTOPLASTY B. CLINICAL REVIEW OF EIGHTEEN CASES\*

W. K. KERR, M.D., F.R.C.S.[C],† A. G. KERESTECI, M.D., B.Sc.‡ and V. N. KYLE, M.D.,‡ Toronto

THE FIRST section of our paper1 was a report on experimental studies of the metabolic aspects of the use of ileal loops in the urinary tract. In this second section, our clinical experience with such reconstructive surgery in the urinary tract of patients will be evaluated. It may be noted that the great majority of reports on ileal loop diversions concern operations in which ureters are inserted into a blind ileal loop with a cutaneous stoma on the abdominal wall and the urine is collected by some apparatus. The short loops of ileum used in these operations and the continuous runoff of urine provide, for many patients, the optimum physiological and biochemical conditions, but at the price of having to use some apparatus for the collection of urine day and night.

In all the operations to be reported here the ileum was used as an internal conduit and even as a reservoir for urine and was connected to the patient's bladder, bladder neck, or urethra. The patients are continent and void their urine in the normal manner per urethram. For this purpose a longer ileal loop is required and, as the urine is stored in the ileum, there is a greater hazard of biochemical disturbance. An evaluation of just how great this metabolic disturbance may be, and whether it is worth taking the risk instead of using a more physiological, but less acceptable procedure, is the main purpose of this review of four years of clinical experience with ileocystoplasties.

#### I. Clinical Material

Eighteen patients have been operated upon with the use of an isolated loop of

ileum in the urinary tract. In three patien is a short isoperistaltic loop of ileum was used to bypass a ureter obstructed by carcinon a or radiation fibrosis. Use of the bowel as an internal conduit connected to the patient's urinary bladder should be sale enough but one patient in the group llustrates the limitations of using bowel replacement in the urinary tract in any manner without producing severe electrolyte imbalance.

The second group consists of 10 patients who, after subtotal cystectomy for tuberculous vesical contracture, intractable cystitis, or neurogenic spastic bladder, have had the ureter or ureters connected to the proximal closed end of an ileal loop which in turn is anastomosed to the bladder neck. The ileal segment here is longer and functions both as a peristalting conduit and as a reservoir. The patient's internal and external urethral sphincters maintain continence of urine, permitting micturition through the urethra at intervals of two to six hours. The majority of these patients are victims of the mechanical sequelæ of healed tuberculous infections of the urinary tract. The fibrous contracture of the bladder has distorted the normal ureterovesical valve so as to permit reflux of urine from the bladder up the ureter. Progressive hydronephrosis is produced by the limited capacity of the urinary tract in these patients and also by the ureteral reflux of urine every time the patient voids, a mechanism which was formerly a cause of renal failure and death in patients with genitourinary tuberculosis (Fig. 1). Nephrostomy, cutaneous ureterostomy or ureterosigmoidostomy was not a satisfactory solution since these procedures entail considerable disability which prevents all but a few from returning to work and since they prolong life by only a few months to a few years.

The third group consists of five patier to with carcinoma of the urinary bladder who have had a radical total cystectomy and prostatectomy. Here again the ureters are

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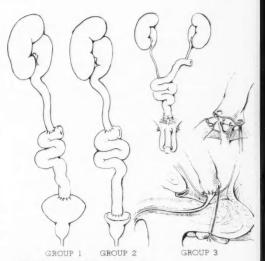
joined to the closed proximal end of a fairly long ileal loop, the distal end of which is connected to the membranous wrethra. These patients have, indeed, an i'eal bladder. They rely for continence entirely on their external wrethral sphincter and void per wrethram (Fig. 1).

We shall consider in detail the surgical aspects, mechanical results, metabolic limitations and prognosis for each of these

roups.

# II. Surgical Aspects—1. Operative Technique

Ileal loops for use in the urinary tract have been isolated from the terminal ileum and the bowel reconstituted with an endto-end two layer anastomosis. This has been satisfactory in all cases. Care is taken in the isolation of the loop to preserve its blood supply and to avoid shortening the mesenteric margins when ligating the mesenteric vessels. This preservation is more important at the distal end of the loop, particularly if it is to be brought all the way down to the floor of the pelvis to be joined to the membranous urethra. Occasionally, splitting the peritoneum of the loop's mesentery may yield additional mobility to the distal end of the loop. The length of ileum to be isolated should be somewhat greater than would appear to be sufficient before the bowel is divided; the loop is prone to shrink unaccountably during the half hour after division. If the loop is to be used as an internal conduit, an eight to 12 inch (20-30 cm.) length is measured out before the bowel is divided. There should be sufficient redundancy of bowel to permit peristalsis. For ileocystoplasty after subtotal and total cystectomy, a greater length of bowel is required not only so that it may reach its destination but also so that it may have a capacity great enough to hold the required amounts of urine (300-500 ml.) at the distal end of the loop and still have an empty peristalting proximal end to protect the kidneys from hydronephrosis. The lengths of loop used have ranged from 12 to 22 inches (30-53 cm.). A longer loop does not appear to lengthen the interval between voiding or increase the amount which the patient



GROUP 1—lleo-ureterocystoplasty
GROUP 2—Subtotal cystectomy and ileocystoplasty
GROUP 3—Total cystectomy and ileoneocystoplasty

voids at one time. However, it does add to the hazard of urea and electrolyte reabsorption. Within the size range indicated above, we have not as yet found any correlation between clinical or laboratory evidence of uræmia or electrolyte imbalance and the length of the loops; but marginal cases must exist where an excessive length of bowel would be detrimental.

The ileum has always been inserted into the urinary tract in an isoperistaltic fashion, the loop being rotated on its mesentery when the proximal end is to be brought up towards the right kidney. U-shaped loops and ring-plasties have been avoided. The proximal end of the loop is closed. We have been uncertain about the length of ureter to leave in situ both when it is normal and when it is dilated and hypertrophied. In most instances, the ureter has been divided just above the pelvic brim, but the more diseased ureter has been divided higher up, towards the renal pelvis. On the left side the ureter is brought through an opening in the mesocolon rather than around the descending or sigmoid colon. The uretero-ileal anastomoses have been made by the elliptical mucosa-to-mucosa technique using a single layer of continuous 4-0 or 5-0 chromic catgut suture without any attempt being made to form

a tunnel. This has always been successful, neither leakage or stenosis having occurred. Reflux is possible but thus far has been overcome by the peristaltic action of the ileum. No attempt is made to place these anastomoses extraperitoneally to close the large gaps through which loops of bowel might pass and become strangulated. We prefer to leave these organs to find their own natural position rather than attempt to suture them in place. So far this has been successful, as none of these patients has developed intestinal obstruction. If both kidnevs are present, the left ureter is brought through the mesocolon, and joined to the proximal closed end of the ileal loop which is then swung over to the right of the midline to permit insertion of the right ureter about two or three inches distal to the left.

Disposal of the distal end of the loop depends on the operation at hand. For a ureteral bypass, the end of the ileum is anastomosed to an opening of similar size in the fundus of the urinary bladder by a single layer of continuous catgut suture. In men a cystotomy tube is left in place, and in women a urethral catheter. In patients with tuberculous vesical contracture the above procedure has not been successful. The stoma may stenose, but even when it does not do so, the urine drains poorly across the stoma.

Finally, the patient's urinary frequency is not relieved while the diseased bladder is still present. It must be remembered that these bladders are an inch to an inch and one half (2.5-3.75 cm.) in thickness, the wall consisting of hypertrophied detrusor muscle interspersed with a large amount of fibrous tissue. In two such patients threequarters to four-fifths of the bladder had to be excised leaving little more than the bladder neck and a portion of the trigone. This subtotal cystectomy is now always performed at the first operation in this group of patients. The open end of the ileum is joined to the remainder of the bladder by a single layer of intestinal catgut suture reinforced with a few interrupted sutures when this appears to be indicated. A urethral catheter is left indwelling. Unless this catheter is large to accommodate the secreted by the ileum, we now also protect this suture line by a more proximal temporary drain. If the patient already has had a nephrostomy, this fistula serves the purpose very well. Otherwise, a temporary pyelostomy or ureterostomy tube is inserted and brought out through the patient's flank. Proximal drainage has been achieved by inserting a catheter in the proximal end of the ileal loop and bringing this out extraperitoneally through a stab wound in the flank.

In the third group of patients, in whom total cystectomy and prostatectomy have been performed for carcinoma of the urinary bladder, the anastomosis of the ileum to the divided end of the membranous urethra is difficult. In some patients the urethra may even be hidden underneath the symphysis pubis. The distal end of the ileum is narrowed down to match the size of the urethra by interrupted sutures, one at each side, which attempt to invert rather than evert the mucous membrane. The ends of these sutures are left long enough to be brought through the pelvis and out in the perineum to be tied over a rubber drain and so anchor the bowel in place. Attempts have been made, with variable success depending on the exposure, to insert four interrupted sutures between the ileum and the urethra. A Folev catheter is left indwelling as a splint to drain the urine. Gentle traction on the balloon also aids in keeping the bowel down to the urethra. The difficulties and sometimes disasters encountered in accomplishing a satisfactory ileo-urethral anastomosis overshadow all other complications. Proximal drainage may help in the future.

Before considering postoperative complications, we should point out one other problem. Although the insertion of an ileal loop to bypass an obstructed ureter is not unduly shocking and may when indicated be performed on sick and elderly patients, the other two operations—ileocystoplasty and its adjunct, subtotal or total cystectomyare both time-consuming, hæmorrhagic, and shock-inducing procedures. One patient had a total radical cystectomy and ileoneocystoplasty with a measured blood loss of only 500 ml., but the average patient loses 150 to 2000 ml. and some perhaps more. Even with such adjuncts as hypotensive anæs-

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thesia, these operations will still be limited to younger patients in fairly good condition.

#### 2. Postoperative Complications.

There were no serious complications with the ileal loop bypass for obstructed ureters, nor should there be any since the requirements to be met are technically simple. Two of the three patients in this group died ix and eight months after operation from carcinoma of the cervix.

As has already been mentioned, ileocystoplasty for vesical contracture was followed by stenosis at the ileovesical junction or it fails to relieve urinary frequency unless most of the diseased bladder is removed. Leakage at the anastomotic site of ileum and residual bladder neck and trigone occasionally occurred but was only temporary and without incident except in one patient, a woman upon whom subtotal cystectomy for tuberculous vesical contracture and total hysterectomy for fibroids were performed. This patient developed a vesicovaginal fistula which failed to heal and later required vaginal repair. No difficulty arose in the other nine patients in whom the distal cut end of the ileum was sutured to the bladder neck.

Major complications were seen in the five patients who had total cystectomy and prostatectomy for carcinoma of the bladder where the ileum had been joined to the membranous urethra. The only operative mortality in the entire series occurred in this group. In the first of these five patients, gross leakage at the ileo-urethral suture line produced generalized peritonitis and evisceration. An attempt was made to detach the ileum from the urethra to bring it out to the abdominal wall. The shortening of the ileum and distortion of appearance in the structures were such that the right ureter was inadvertently and unknowingly detached from the ileum. This was only discovered when urinary leakage persisted. Right nephrectomy was performed as a last resort on a very ill patient who soon succumbed. In the second and third patients of this group similar urinary leakage at the ileo-urethral suture line took place, and, although temporary, probably played a part in these two patients also eviscerating. In the fourth patient slight leakage took place, but the abdominal wound healed well. The second patient died of recurrent carcinoma in six months' time. but the other three patients are alive and well after six and 12 months. There can be no doubt that inadequate drainage through the urethral Foley catheter, over which the ileo-urethral anastomosis is made, is due to inevitable obstruction of the catheters by mucus, permitting retention of urine in the lower end of the ileal loop; and that the leakage develops and is liable to persist as a result of this. Other factors contributing to inadequate drainage are tension on the suture line due to a short mesenteric margin and a possible impairment of the blood supply of the ileal loop that may be prevented by careful surgery. The problem of mucus interfering with drainage, however, must be met by improved and more proximal temporary urinary drainage as indicated in the previous section. This was applied in the last patient and no leakage took place. Once catheters are removed there is no further trouble with mucus in the urine in spite of the fact that it may continue to be present for as long as four

Urinary infection has unfortunately been present in all 18 patients and could not be eradicated in any of them. Bouts of clinical pyelonephritis occurred in four patients in the early postoperative period. The majority of infections were due to coliform organisms. One patient, a paraplegic, had had recurrent episodes of pyelonephritis and cystitis for two years before ileocystoplasty. Although he had an exacerbation of this infection at the time of the operation, he has had only one overt attack during a three year period following the operation. Two other patients had resistant urinary infections postoperatively. One of these has had two bouts of pyelonephritis associated with the passage of renal calculi, one bout occurring one month and the other one year postoperatively. Two patients have developed epididymitis postoperatively. The fourth patient to develop pyelonephritis did so following cystography. Ureteral reflux from the ileal bladder was certainly the cause of this infection which was very nearly fatal and precipitated a very severe

metabolic derangement which will be described later. Since that time, routine postoperative cystograms have been abandoned.

One patient, who had an ileocystoplasty following subtotal cystectomy for neurogenic bladder dysfunction, has a urethral diverticulum. Loss of sensation has prevented him from gaining urinary control; thus a collecting apparatus is still necessary. The condom drainage applied to the penis with Elastoplast adhesive has made the diverticulum larger every year. This patient has now had to have a perineal urethrostomy as a temporary diversion in preparation for later repair of the diverticulum. This is a problem to be considered carefully before an ileocystoplasty is performed on a paraplegic.

#### III. Mechanical Results.

Ileocystoplasty will now be evaluated as regards prevention or relief of hydrone-phrosis, reflux, frequency of micturition and nocturia, continence and residual urine. Generally, the results have been excellent for all three groups.

Hydronephrosis, which was present in thirteen kidneys before operation, was improved in all but one. None of the patients with previously normal kidneys has developed hydronephrosis. Reflux, which is anatomically possible and which was demonstrated by retrograde cystography in two-thirds of the kidneys, does not appear to be a problem so far as we can determine. It is dangerous to test a patient for reflux because of the risk of infection.

Bladder function is not altered in patients with normal bladders in whom the ileum is used only as a ureteral bypass. Following ileocystoplasty after subtotal cystectomy, adequate bladder function is attained one to two weeks after removal of the urethral catheter or three to four weeks after the operation. At first there may be some frequency and precipitancy, but continued adaptation takes place over a period of several weeks to several months until practically normal bladder function is present with only occasional nocturia once a night. Good streams are the rule once continence is established. Seven out of ten patients who have had this operation have returned

to their previous occupations. Residual urine may be demonstrated by catheterization or by x-ray in all patients and is of the order of two to six ounces. Excretory urcgraphy in these patients shows that the proximal end of the ileal loop acts as a peristalting ureter while the distal en l dilates and acts as a reservoir which empties without apparent reflux but which leaves a small amount of residual urine. Voiding is stimulated by a lower abdominal sense of fullness. Micturition may take place in one continuous stream or in two or three instalments. One patient was able to void twenty ounces in one continuous stream. An average performance is three to six ounces every two to six hours.

Where ileoneocystoplasty has been performed after total cystectomy and prostatectomy in the male, there is only the external sphincter to rely upon for control of micturition, and as a result bladder function is less certain. Of the four patients who survived operation, one remained totally incontinent and died of residual carcinoma eight months later. The second patient is completely continent and voids three to four times a day and occasionally once at night. The third and fourth patients void every one and a half hours to three hours during the day and have nocturia two to three times. They have sufficient precipitancy to require a portable urinal on important social occasions. All three survivors have returned to their previous occupations. two as sheet metal workers, and one as a farmer. An important consideration in retention of urinary control is careful preservation of the external sphincter at operation. Apart from this we are not aware of any means whereby greater assurance of con-

#### TABLE I.—Type of Ileal Substitution

GROUP 1 Ileo-ureterocystoplasty	
	2 cases
(b) Ureteral obstruction from invasive	
carcinoma of the cervix	1 cass

GROUP 2 Ileocystoplasty following subtotal cystectomy

- (a) Tuberculous contracture of the bladder with reflux and hydroureter 8 cases
- (c) Neurogenic bladder dysfunction... 1 cas
- GROUP 3 Ileoneocystoplasty following total cystectomy and prostatectomy

  (a) Carcinoma of the bladder...... 5 cas so

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tinence may be achieved. In women, if the carcinoma is anywhere near the bladder neck, the urethra should be sacrificed in order to prevent recurrence of disease. However, if the carcinoma is localized and away from the bladder neck or trigone, a partial cystectomy may be all that is required. These problems make ileoneocystop asty so difficult in women as to be rarely it dicated.

#### IV. Metabolic Aspects.

Fourteen of 18 patients presented are alive. Two of them have suffered severe electrolyte derangements. Eight others have shown hyperchloræmia; only three have shown any degree of acidosis.

Table II summarizes the present status of the cases under review.

Severe electrolyte disturbances occurred in Case 1 (C.O. age 65). She was admitted with right-sided ureteral obstruction following high voltage radiation therapy of a Stage I carcinoma of the cervix. She gave a 40-year history of chronic glomerulonephritis and on admission had left sided nephrolithiasis, albuminuria and a non-protein nitrogen (N.P.N.) of 95 mg. %. In September 1955 a right sided uretero-ileocystoplasty was performed, using 10 inches (25 cm.) of ileum to bypass the fibrotic ureteral obstruction. Postoperatively the patient's N.P.N. steadily rose to 160 mg. % necessitating a left nephrolithotomy and temporary nephrostomy. The N.P.N. fell to 76 mg. % and the patient was discharged with a low carbon dioxide combining power (CO2 C.P.). On a high-fluid, low-salt diet she was able to return to work, but 14 months after operation she was readmitted with hyperchloræmic acidosis and dependent ædema. The serum chloride level was 126.4 mEq./l., blood pH 7.22 and N.P.N. 76 mg. %. She was treated successfully with intravenous sodium bicarbonate. A cystogram and retrograde pyelogram revealed reflux up the ileal ureter with evidence of slight hydronephrosis and pyelonephritic clubbing of the minor calices. Coliform organisms predominated in urine cultures. Since this first readmission the patient has been in hyperchloræmic acidosis at least five times with serum chloride levels reaching as high as 125.5 mEq./l. and CO<sub>2</sub>C.P. falling as low as 7.3 mEq./l. During each admission the N.P.N. has been greater than 150 mg. %, reaching 254 mg. % during one admission. In this patient the severely damaged kidneys are unable to deal with the chloride absorbed from the ileum and this results in hyperchloræmia and acidosis although the ileal segment in this patient is shorter (10 inches) than any other in the series and is used only as an internal conduit and not as a reservoir for urine.

The second patient to develop a severe electrolyte disturbance was Case 7 (Table II, Miss M.T., age 32). This patient was admitted to the Toronto Hospital for Tuberculosis in December 1954 with a bilateral renal tuberculosis. After a 20-month course of treatment with antituberculous drugs, it was felt that the disease was arrested. However, she was left with a contracted urinary bladder with ureteral reflux on both sides and frequency every 45 minutes during the day and every two hours at night. An ileocystoplasty was performed, the ureters being connected to a 22inch (55 cm.) length of ileum which was joined to the fundus of the bladder. Six months after this operation, frequency had not been relieved. A cystogram revealed that very little opaque material entered the ileum and that the bladder capacity was unchanged. In June 1956, the bladder was removed and the distal end of the ileal loop anastomosed to the bladder neck. Postoperative cystography revealed right ureteral reflux and was followed by severe right-sided pyelonephritis. The patient was discharged in August 1956, with a voiding capicity of 280 ml. and frequency every two and a half to three hours daily and once or twice at night. In December, five months after the second operation, she was readmitted acutely ill with pyelonephritis, dehydration, hyperchloræmic acidosis and hypokalæmia (see Table III). Despite treatment with intravenous fluids, molar lactate and potassium citrate the serum potassium fell to 1.4 mEq./l.\* During the next two weeks treatment with bicarbonate and potassium (67 mEq./day) was carried out but the patient remained clinically ill and weak with moderate acidosis (CO,C.P. 8-12 mEq./l.) and a serum potassium level which ranged between 2.3 and 3.2 mEq./l. It appeared difficult to correct the acidosis. A metabolic balance study was now carried out on electrolyte intake and output. After the patient had been observed for a week on a standard diet, † a diet supplement was given consisting of sodium and potassium citrate solution containing 60 mEq. of each anion per day. There was almost immediate clinical improvement. Over the next 14 days during which this supplement was used, the potassium

<sup>\*</sup>Combined oral and parenteral potassium during this period was 200-290 mEq./day.

<sup>†</sup>The standard diet contained 67 mEq. potassium daily.

TABLE II.—SUMMARY OF CASES

Pe	Patient	Age	Sex	Diagnosis	Operation	Na. mEq./l.	Na. Cl. K CO <sub>2</sub> CP N.P.N mEq./l. mEq./l. mEq./l. mg.	K K mEq./l.	Eq./l. mEq./l. mg. %	N.P.N. mg.	or B.	U.N*. Follow-up	Occupation*
-	C.O.	62	দ	Carcinoma cervix	Heoureteroplasty right	133	1117	.00 .00	7.4	200		4 years	Clerk for 3 years, now too ill.
2	G.M.	35	1	7	", left	134	102	3.2	29	37		Died 8 months	1
00	L.S.	31	H	. 3	right	138		2.8	29	38		Died 6 weeks	I
4	C.D.	33	M	Tuberculosis	Subtotal cystectomy and	136	114	4.9	56		28	4½ years	Railway engineer
LC.	A I.	30	[*		neocystopiasty right	133	106	50	90		05	4 years	Stenooranher
9	PS	16	W	33		136	115	3.7	25		25	4 vears	Technician and night
				:									school.
2	M.T.	32	-	39	" bilateral	147	110	5.5	56		17	31/2 years	Switchboard operator
00	O.T.	46	E4	. 3	,, right	125	111	4.5	26		19	2½ years	Housewife
6	P.K.	31	M	. 79	" left	144	106	4.4	56		33	2 years	Well but unemployed
	L.S.	16	M	. 3	" left	140	109	4.4	27		17	3/4 years	Student
	J.N.	16	F	3	" left	138	108	4.5	24		29	3/4 years	Student
12	D.B.	17	M	Quadriplegia	" bilateral	133	86	4.0	25	33		3½ years	In hospital with bed
													sores.
	H.D.	65	M	Chronic cystitis proved to be carcinoma.	" bilateral	141	105	4.1	29	40		2 years	Improved but unable to work.
14	A.N.	63	M	Carcinoma bladder	Total cystectomy and ileoneocystoplasty	131	109	5.0	17	45		Died 3 weeks	
	D.H.	41	M	Mary Mary	99	132	112	3.8	30	39		Died 8 months	1
16	V.L.	57	M	99	99	150	107	4.4	25	46		1½ years	Sheet metal work
	J.G.	47	M	. 99	. 3	140	107	3.0	33	37		1 year	Sheet metal work
	CK	63	Z			143	100	4.7	233	36		2 months	Farming

\* Present serum electrolyte and urea values and occupation are given for all survivors and terminal values for patients who died.

TABLE III.—Ileocystoplasty Complicated by Pyelonephritis, Acidosis and Hypokalæmia (Case 7, Miss M.T.)

				1000	~			
Date		B.U.N. or $N.P.N.$ $mg.%$		Na $mEq$	./l.	CO <sub>2</sub> C.P. mEq.		Remarks
Ju y	1956	25		139 138 134	104 96 107	24.1 28.1	4.2 5.8 2.6	Ileocystoplasty Revision of ileocystoplasty Discharged from hospital
Dec. Dec. Dec.	20/56		39 60 57	139 135 143 137	111 109 104 100 113	18.1 7.3 24.0 28.0 17.0	2.4 3.0 1.4 1.8 3.7	Readmitted with pyelonephritis, dehydration, acidosis and hypokalæmia
Feb.	18/57 1 10			139 143 141	110 110 106	11.0 26.0 19.0	2.4 4.2 4.9	On metabolic balance study with Na & K supplement
	1958 1959			141 147	109 110	20.0 26.0	4.7 5.5	Well and working with Na & K supplement

retained in excess to that excreted amounted to 844 milliequivalents (Table IV). The re-

TABLE IV.—Potassium Balance Study (Case 7, Miss M.T.)

Date		K intake $mEq$ .		K balance mEq.
Jan. 18	2.4	63.0	73.6	-10.6
19		67.6	43.3	+24.6
20		67.3	51.4	+15.9
21	2.3	67.4	67.9	-0.5
22		64.6	55.1	+9.5
23	2.9	127.4	46.3	+81.1
24		123.0	42.7	+80.3
25	3.3	127.4	39.6	+87.8
26	4.6	127.0	50.8	+76.2
27	4.1	127.2	42.0	+85.2
28	3.9	126.4	45.4	+81.0
29		124,6	60.2	+64.4
30	4.4	127.3	66.1	+61.2
31		127.4	62.5	+64.9
Feb. 1	4.2	126.5	. 98.0	+28.5
2		126.8	84.8	+42.0
3		127.2	115.0	+12.2
4	4.4	127.2	110.5	+16.7

14 days Total potassium retained 844.2 mEq.

covery from severe illness with the above treatment was spectacular. During the past three years the patient has remained well and working on a high-fluid, low-salt diet supplemented by 60 mEq. of sodium and potassium citrate a day. The cause of this patient's metabolic disturbance three years ago is thought to have been the marginal renal function which became grossly impaired owing to pyelonephritis and unable to compensate for chloride reabsorption from the ileal loop.

Conditions in a third patient afforded a unique opportunity of studying the absorption of the various urinary electrolytes by the ileal loop. A young man (Case 9, P.K. age 30) with

a history of right nephrectomy for tuberculosis presented with active tuberculosis of the remaining kidney, vesical contracture and ureteral reflux with hydronephrosis and also a stricture of the urethra. A preliminary left nephrostomy was performed. After six months of nephrostomy drainage and antituberculous drug therapy it was considered safe to proceed with the ileocystoplasty. The nephrostomy tube was left in place for some time after the operation until adequate function of the newly formed bladder was ensured. This allowed analysis of the urine before and after traversing the ileal bladder (Fig. 2).

Starting with the first postoperative day, 24-hour urine samples from both the nephros-

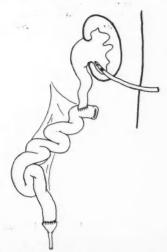


Fig. 2.—Subtotal cystectomy and ileocystoplasty after preliminary nephrostomy on Case 9, Mr. P.K.

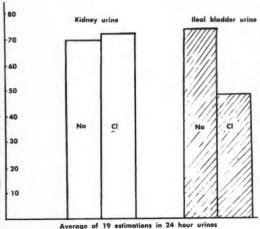
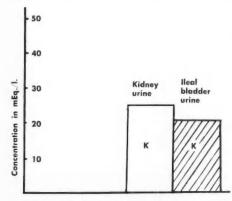


Fig. 3.—Comparison of kidney and ileal urine with respect to sodium and chloride ions in Case 9, Mr. P.K.

tomy tube and the urethral catheter in the ileal bladder were collected. Urine samples from both sources were analyzed for sodium, chloride, potassium, pH and specific gravity. The actual number of milliequivalents excreted by the kidney and reabsorbed by the ileal bladder is unknown, since there was no way of determining the volume of urine delivered to the ileal bladder.

Figs. 3 and 4 show a comparison of concentrations of sodium, chloride and potassium in milliequivalents per litre in 19 consecutive days of 24-hour urine collections from the kidney and in ileal bladder urine. More chloride than sodium was reabsorbed leaving an average con-



Average of 19 estimations in 24 hour urines

Fig. 4.—Comparison of kidney and ileal urine with respect to potassium ions in Case 9, Mr. P.K.

centration of 30 mEq./l. less chloride than sodium on passage through the ileal loop. The findings with potassium were of particular nterest in view of the severe depletion in the patient. It was found that potassium like chloride is reabsorbed from the ileal loop. The hypokalæmia in our previous patient (M.1.) must, therefore, have been of prerenal and recal origin, and due to acidosis and dehydration.

Table V shows the average serum electrolyte readings before and after ileocystoplasty. The reabsorption of chloride ions in excess of sodium ions is reflected in hyperchloræmia. The carbon dioxide combining power is just below normal and does not show any difference in the two periods. Therefore, a compensated hyperchloræmia exists. The preoperative and postoperative potassium levels are both normal.

TABLE V.—Average Serum Electrolytes Before and After Ileocystoplasty (Case 9, Mr. P.K.)

(CASE O, I	AR. 1 .11./
perative	Postoperative
7.38	7.37
P. 23.2	23.4 mEq./l.
138.3	136.4 mEq./l.
4.8	4.13 mEq./l.
103.7	109.0 mEq./l.
. 19	21 mg. %
age of 7	Average of 22
nations	estimations
	Perative 7.38 P. 23.2 138.3 4.8 103.7 19 age of 7

Three additional patients were studied in a similar fashion. Two of these patients also had solitary kidneys and at operation had proximal diversion of urine at both kidney and upper end of the ileal bladder and one patient with two kidneys had a tube in the proximal end of the ileal loop. These cases therefore allowed analysis of pre-ileal and post-ileal urine.

The results in one case showed that sodium and chloride ions were reabsorbed milliequivalent for milliequivalent and that potassium was consistently absorbed, as was the case with Mr. P.K.

The second case confirmed the consistent absorption of potassium from the ileal loop but gave inconsistent results for sodium and chloride ions which were variably secreted or reabsorbed. Most of the urine drain of from the proximal tube, and it may be that the scant samples of urine collected from the urethral catheter were not representative.

The third case also confirmed the reabsorption of potassium. In observations made when sufficient urine was collected

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from both catheters to be representative, the results of sodium and chloride estimations showed reabsorption of chloride in excess of sodium.

Ten of the 14 survivors have shown a degree of hyperchloræmia at one time or another. Five have had lowered carbon d oxide combining powers. Of the 10 with h perchloræmia, eight have at least mode ate renal insufficiency, five having only one kidney. Of the five with acidosis all have moderate to severe renal damage, with fixed specific gravities of urine at 1.012 to 1014. One patient has shown persistent hyperchloræmic acidosis and another persistent hyperchloræmia without acidosis despite medical therapy consisting of high fluid intake, salt restriction and alkali administration. Both of these patients have significant renal impairment. The remaining eight patients have had only transitory electrolyte aberrations which have responded to treatment.

These patients have been placed on a high-fluid, low-salt diet immediately following operation. Supplementary oral sodium and potassium citrate or carbonate are given only if indicated by the serum electrolyte levels. This diet should ensure the safest urine possible: that is, one of a low specific gravity, low salt content with cation replacement and prevention of dehydration. However, potassium replacement should not be necessary if adequate water intake is maintained.

#### DISCUSSION

The first section of this publication dealt with absorption studies in dogs of the changes in urine instilled into isolated loops of ileum. It was found that the volume of urine changed depending upon the specific gravity of the urine: urine of low specific gravity being reabsorbed and urine of high specific gravity being diluted by intestinal secretions. Sodium and chloride absorption varied with the concentrations of these ions for urines of similar specific gravity but was greatly modified by alterations of urinary specific gravity. For the same concentration of sodium and chloride, urine of high specific gravity showed much less absorption than did that of low specific gravity. The ileum reabsorbed more chloride than sodium at all concentrations of these ions and independent of specific gravity. Potassium and urea were both reabsorbed in linear relation to their concentration, and more with urine of low specific gravity than with that of high specific gravity. These results are similar to those reported in experiments on the colon, except that potassium is reabsorbed by the ileum. The pathogenesis of hyperchloræmic acidosis when it does occur with the use of ileum in the urinary tract is, therefore, similar to that in ureterocolic anastomoses.

This second section presents our observations on 18 ileocystoplasties. It is evident from these observations that not only is there a tendency towards hyperchloræmic acidosis when urine traverses ileal loops but also that hypokalæmia, so chronic and constant in ureterosigmoidostomies, may occur in patients with ileocystoplasties.

There is less clinical evidence of hyperchloræmic acidosis occurring with ileocystoplasties than with ureterosigmoidostomies. Ferris and Odel<sup>2</sup> in 1950 found in a study of 141 patients with bilateral ureterosigmoidostomies, that 79% had hyperchloræmia and 80% acidosis. In 1953, Wilson3 reported a case of uretero-ileostomy where hyperchloræmic acidosis developed. Since then, others have reported similar problems with ileal conduit procedures. In 1958, Johnston and Rickham4 reported 31 cases of uretero-ileostomy in children. Three of these children developed severe hyperchloræmic acidosis, two of the three having had very poor preoperative kidney function. A fourth report came from Moonen<sup>5</sup> in Holland who reported that 50% of ileocystoplasties performed for genito-urinary tuberculosis led to electrolyte disturbances during the first postoperative months. On the other hand, many favourable results of the use of ileum as a bladder supplement or substitute with fewer instances of electrolyte upsets have been described. In 1957, Bricker<sup>6</sup> reappraised 175 uretero-ileostomies none of which was followed by hyperchloræmic acidosis, and hyperchloræmia occurred only occasionally. However, all the ileal conduits in Bricker's series were very short, seven to eight inches (17.5-20 cm.) in length, and all emptied on to the abdominal wall. Additional favourable references are found in articles by Read and Hurwitz,<sup>7</sup> Pyrah,<sup>8</sup> and Stamey and Scott.<sup>9</sup> In 1956, Wells<sup>10</sup> compared the results as regards electrolytes of Jacobs' and Stirling's<sup>11</sup> ureterocolic anastomoses with a series of ileal ureterostomies. He found a 50% fall in the incidence of acidosis; the incidence of hypokalæmia was essentially the same in the two groups.

The observations presented in our series confirm the recorded reports of Johnston et al.4 and Moonen<sup>5</sup> concerning the tendency towards hyperchloræmic acidosis when segments of small bowel are interposed in the urinary tract. The relation between electrolyte balance and renal function is clear: the incidence of imbalance rises with the degree of renal insufficiency. Two patients with moderate renal damage preoperatively have not suffered any metabolic derangements. Nevertheless, the evidence in this review indicates that electrolyte disturbances tend to occur in those patients with kidneys which are not able to compensate for the absorption of urinary constituents from the ileum. Also well demonstrated is the fact that episodes of pyelonephritis may be attended by severe metabolic disturbances. More accurate quantitative assessment of renal function of these patients preoperatively might have given a closer correlation with subsequent

The etiology of the metabolic disorders has been made clear in a review by Stamev. 12 It is established that there is a preferential absorption of chloride ions in excess of sodium ions from the ileum. Even when the absorption of these two electrolytes is milliequivalent for milliequivalent, the absorbed mixture is acidotic since the normal ratio of sodium to chloride in the serum is 1.0 to 0.7. In addition, there is a greater sodium space in the body than chloride space, the chlorides being mainly extracellular. The presence of polyvalent anions in the urine, especially phosphate, enhances chloride absorption. The kidneys, if normal, attempt to combat the resultant hyperchloræmia by elaborating more ammonia to excrete with the excess acids, thus establishing the opportunity for intestinal absorption of ammonium chloride as well

as sodium chloride. When absorbed, the ammonium chloride is converted to urea and hydrochloric acid, elevating the blood urea nitrogen and depressing the carbon dioxide combining power. The constant absorption of sodium chloride leads to an osmotic diuresis with obligatory polyura, cellular dehydration and potassium cepletion. The kidneys lose potassium with this diuresis and are, therefore, establishing a vicious circle since hypokalæmia is nephrotoxic, tending to produce further impairment of renal function. If the kidneys are defective preoperatively, loss of pure renal potassium as well as an inability to deal with an otherwise compensatable hyperchloræmia may be the cause of most of the serious metabolic upsets with ileocystoplasties.

We conclude that ileocystoplasty is superior to ureterosigmoid transplantation in respect to metabolic disturbance, and that the use of ileum in the urinary tract as an internal conduit is well tolerated. Even the use of ileum to replace all or a portion of the urinary bladder, retaining the urethra as a continent exit for the urine. has been found mechanically satisfactory and metabolically acceptable. We do not think there is any justification for ileal conduit operations to the skin in patients who have an intact urethra with sphincter control. If this is not the case but rectal control is present, ureterosigmoid transplantation is still a fair compromise now that medical control of the attendant metabolic disturbance is better understood.

#### SUMMARY

This is the second of two sections and deals with the surgical features and metabolic aspects of 18 cases in which ileum was used to remodel the urinary tract. These cases are divided into three groups consisting of three patients with ureter-ileocystoplasties, 10 with ileocystoplastics, and five with ileoneocystoplastics after to all cystectomy for carcinoma.

There were early surgical problems with urinary fistula at the ileo-urethral anasomosis in the group in which complete cystectomy was performed. Proximal divirsion of urine and an improved technique

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distal ileo-urethral anastomosis have overcome this problem. The incidence of ascending pyelonephritis was low in spite of the fact that asymptomatic urinary infection is the rule, with coliform organisms predominating. Satisfactory relief of hydronephrosis has been usual. Urinary control h s been excellent, enabling patients to return to their previous occupations.

Ten of the 14 survivors have had hypercl loræmia and five have had a lowered carbon dioxide combining power. The majocity of these patients have moderate renal impairment with specific gravity fixed at 1.)12 to 1.014. One patient, who has chronic h perchloræmic acidosis, has very poor renal function. Another patient had an episode of hyperchloræmic acidosis associated with a severe bout of pyelonephritis. During this she also had a severe depletion of body potassium. Eight patients have had only transient electrolyte disturbances which have responded satisfactorily to treatment with oral supplements of sodium and potassium citrate.

In four patients the urinary electrolytes were studied before and after the urine passing through the ileal loop. The results confirm the observations reported in our animal experiments. There was a preferential absorption of chloride ions in excess of sodium ions which we believe accounts for the tendency to hyperchloræmia in most patients, and the gross temporary acidosis in one patient and persistent acidosis in another. In the animal experiments it was shown that potassium was reabsorbed by the ileum; this has been found to be true also in these clinical studies. Hypokalæmia, which occurred in one of our patients, is, therefore, not due to washing away of potassium from the ileal loop but is of prerenal and renal origin just as in ureterosigmoidostomies.

Our conclusion is that the ileum has a definite although limited use in remodelling the urinary tract. It is excellent for replacing the ureter and most of the bladder in tuberculous contracture and has a limited use after total cystectomy for carcinoma.

Where defects of urethra and sphincter control prohibit ileocystoplasty, we would still consider ureterosigmoid transplantation before submitting a patient to an ileal conduit to the skin.

#### ACKNOWLEDGMENT

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#### RÉSUMÉ

Cet article fait suite à un autre publié antérieurement dans ce journal et traite de l'aspect chirurgical et métabolique de 18 malades chez qui on employa une anse de grêle dans la réfection des voies urinaires. La série se divise en trois groupes: trois malades ayant subi une urétéro-iléo-cystoplastie, dix une iléo-cystoplastie et cinq une iléo-néocystoplastie après cystectomie totale pour cancer.

Les fistules urinaires au niveau de l'anastomose iléo-urétrale présentèrent un problème chirurgical tôt au cours du traitement de ceux chez qui on

pratiqua une cystectomies complète. Le détournement du flot urinaire en amont ainsi qu'une amé-lioration dans la technique de l'anastomose eurent raison de cette difficulté. La fréquence des pyélonéphrites ascendantes fut moins élevée que celle que l'on trouve dans les anastomoses urétérocoliques, bien que les infections urinaires où prédomine le colibacille soient souvent silencieuses. Dans la plupart des cas l'hydronéphrose fut soulagée. La continence urinaire devint excellente permettant le retour des malades à leurs occupations antérieures.

Dix des 14 survivants ont fait de l'hyperchlorémie et cinq ont subi une diminution de la réserve alcaline. La plupart d'entre eux ont une fonction rénale hypothéquée et secrètent une urine dont la densité est fixée à environ 1.012 ou 1.014. L'un densité est fixee a environ 1.012 de d'eux, qui fait de l'acidose hyperchlorémique, possède une fonction rénale des plus pauvres. autre a traversé une phase d'acidose hyperchlorémique et de déficit potassique prononcé au cours d'une attaque grave de pyélonéphrite. Huit malades n'ont subi qu'un déséquilibre électrolytique transi-

toire corrigé par l'administration orale de supplément sodique et potassique sous forme de citrates. Dans quatre cas on a étudié les électrolytes urinaires avant et après leur passage au travers l'anse iléale. Les résultats ont confirmé l'observation ecueillie au cours de l'expérimentation animale, que l'absorption des ions de chlore s'établit le préférence à celle des ions de sodium. Ce dé é-quilibre expliquerait la tendance de ces malaces à l'hyperchlorémie de même qu'à l'acidose tem oraire chez l'un d'eux et persistante chez un aut e. chez un deux e persistante chez un aut e. L'iléon réabsorbe le potassium chez l'hum in comme chez l'animal, tel que l'avaient démon ré les expériences de laboratoire. L'hypokalién ie d'une de ces malades n'est donc pas le résul at l'avaient de l'avaien d'une perte de potassium dans l'anse iléale; m is cette perturbation remonte au contraire à une origine rénale ou pré-rénale tout comme dans es cas d'urétéro-sigmoïdostomie.

L'iléon possède donc une importance limitée mais bien établie dans la plastie des voies uri-naires. Il remplace bien l'uretère et la plus grande partie de la vessie dans les cystites tuberculeuses avec contraction vésicale. Il peut aussi servir après cystectomie totale dans les cas de cancer. Lorsqu'une malformation de l'urètre ou un défaut du mécanisme régulateur du sphincter empêche le recours à l'iléo-cystoplastie, les auteurs préfèrent l'urétéro-sigmoïdostomie à l'implantation d'une anse de grêle isolée, abouchée à la peau.

# URETEROINTESTINAL TRANSPLANTATIONS®

". . . Two major complications have seriously curtailed the application of ureterointestinal anastomosis: (1) renal infection and hydronephrosis and (2) electrolytic imbalance due to the absorption of urinary constituents by the intestinal mucosa.† It is now appreciated that the ultimate mortality from renal infection and hydronephrosis is so large that any possible gain in the survival rate after radical cancer operations that necessitate ureterointestinal transplantations may be nullified by the urinary

tract complications. Clinical ill effects resulting from electrolytic imbalance have contributed to an unappealingly high incidence of invalidism. Consequently, ureterointestinal transplantation is falling into disfavour and the acceptability of procedures such as total cystectomy and other forms of exenteration for pelvic cancer is being jeopardized. Surgeons have accordingly been forced to resort to uretero-ileostomy types of transplantation, which however require an additional stoma and a cumbersome urine collecting appliance.

"Ureterointestinal transplantation is applicable not only for malignant neoplasms of the bladder and extensive tumors in the female pelvis, but has also been the procedure of choice in bladder exstrophy, extensive vesic >vaginal fistulas, and certain types of urina y incontinence not satisfactorily controlled by conservative measures. Improved types of ur >terointestinal anastomosis which might have less serious disadvantages would obviously be a major contribution in surgery.'

<sup>\*</sup>Peng, B., Morales, P. A. and Hotchkiss, R. S.: Comparative studies on ureterorectal sigmoidostomy, ureteroileal sigmoidostomy and ureteroileocecal sigmoidostomy, J. Urol., 82: 462, 1959.

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#### GALLSTONE ILEUS

ROBERT B. ANDREW, M.D., F.R.C.S.[C], F.A.C.S., Riverside, Ont.

Bowel obstruction due to a large gallstone becoming impacted somewhere along the course of the gastrointestinal tract is a well-known clinical syndrome. It is not the jurpose of this paper to conduct a statistical survey of the literature, to conjecture as to the mechanism of transfer of gallstone to intestinal lumen, or indeed to review in cetail the symptomatology, diagnostic criteria or therapy of the disease. Rather, it is hoped, by means of brief case illustrations, to recall the bizarre clinical course and to illustrate some of the radiographic appearances which may suggest a correct preoperative diagnosis. As will be shown, it is with those patients in whom conservative management has been prolonged that the mortality rate is high, whereas early diagnosis and early operative intervention lead to a satisfactory outcome.

The author, who had previously seen only one patient with gallstone ileus, became more aware of this condition when he operated with an incorrect diagnosis upon the first patient (Case 1) in the winter of 1955. This led to a more accurate appreciation of the symptoms and findings in Cases 5, 6 and 7 during the following three and a half years. The remaining three histories (Cases 2, 3 and 4), presented with the kind permission of the attending surgeons, were selected chiefly for the purpose of illustrating certain other radiographic appearances which may be encountered.

Case 1.—Mrs. E.T., an 81 year old grandmother, had experienced no significant recent illness until some six weeks before admission. At that time she complained of upper abdominal discomfort, nausea and occasional vomiting. Six days before hospital admission the vomiting became more frequent, bowel movements ceased, and abdominal distension began.

The patient, however, refused medical attention until the day of admission. A diagnosis of bowel obstruction was readily made and a flat film of the abdomen was taken. The clinical



Fig. 1.—Case 1. The radiograph suggested an obstruction in the splenic flexure of the colon, A review of the films after operation suggests that a calculus is shown in the small bowel overlying the colon.

impression of obstruction high in the left bowel seemed supported by the passage of sanguineous material per rectum, Sigmoidoscopic examination was negative. Barium introduced by enema was arrested at the splenic flexure (Fig. 1). There now seemed to be little doubt that a neoplasm of the transverse colon was present, producing the obstruction. Plans for colostomy were completed. Because of the poor condition of the patient it was necessary to delay long enough for adequate preparation.

It is anticlimactic to state that there was no colon lesion. A large gallstone was found impacted in the mid-ileum and was removed. The patient's condition deteriorated rapidly and she died 18 hours after operation. Extensive coronary atherosclerosis was present on postmortem examination. Review of the films suggests that a calculus is shown in the small bowel overlying the splenic flexure.

CASE 2.—Mrs. M.R., a 76 year old woman had survived 12 years after an abdomino-

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Fig. 2a
Fig. 2b.—Case 2. Calculus in the gall-bladder. Fig. 2b.—Case 2. The calculus is lodged at the colostomy opening.

perineal resection for cancer of the rectum. It had been known for several years that there was a large calculus in the gall-bladder (Fig. 2a). An attack of upper abdominal pain and vomiting, suggestive of early small bowel obstruction, resulted in her admission to hospital. A scout film of the abdomen revealed that the large calculus was no longer in the right upper quadrant but had passed into the small bowel. The patient was observed carefully for signs suggesting complete obstruction or vascular impairment, the progress of the stone being followed by daily radiographs. Three days after admission it had reached the colostomy stoma where it was removed digitally (Fig. 2b). The patient recovered, to die two years later from a ruptured aortic aneurysm.

Case 3.—Radiographs taken over a 10 year period had shown multiple gallstones in Mrs. M.B., a 66 year old woman, who had repeated attacks of biliary colic. She was admitted to hospital with acute right upper quadrant pain. Three days after the onset the typical lesions of herpes zoster appeared over the distribution of the ninth and tenth right intercostal nerves. Three months later she was readmitted after 24 hours of vomiting, crampy abdominal pain and distension. A diagnosis of small bowel obstruction was made. X-ray examination revealed distended small bowel with a radio-opaque calculus in the left lower quadrant

(Fig. 3). Barium enema examination was negative. As well, stones were present in the right upper quadrant. The small bowel obstruction became complete. Laparotomy resulted in removal of a stone from the upper ileum. The patient did well, returning four years later for cholecystectomy and removal of a gallstone from the common bile duct.

Case 4.—Mrs. A.F., 80 years old, had been aware of subcostal pain and obstipation for six months. For six years she had received periodic hypodermic injections for "gall-bladder attacks". For the past two weeks the colicky abdominal pain had become increasingly severe. There had been repeated vomiting and total constipation. The abdomen had become distended but not tender.

Scout films of the abdomen revealed a bowel pattern suggestive of small bowel obstruction. Further, the radiologist recognized the presence of free air in the biliary tree (Fig. 4). A correct preoperative diagnosis of cholecysto-duodenal fistula and gallstone ileus was made, and, after adequate preoperative preparation, an impacted stone was removed from milipipunum. The patient made a satisfactory recovery.

CASE 5.—Mrs. E.T., an 86 year old resident of a nursing home, had never complained, until her recent illness, of indigestion of any typ?. She was first seen two weeks before hospital



Fig. 3.—Case 3. A large calculus is shown in the left lower quadrant.

admission when she complained of diffuse abdominal pain, occasional vomiting and diarrhea. Symptomatic therapy for gastroenteritis was prescribed. Over the next two weeks vomiting continued intermittently; she was able to tolerate some fluids. Bowel movements occurred only with enemata.

Because of the persistence of the vomiting, hospital admission was arranged under a tentative diagnosis of gastric neoplasm. On repeated examination of the abdomen over the two week period there was no distension, tenderness, masses or other abnormal findings suggestive of a significant intra-abdominal lesion. Her moderately dehydrated state was corrected with intravenous fluids, intermittent vomiting persisting meanwhile.

An upper gastrointestinal series was carried out and a set of films obtained which may be unique. It appears that the barium arrived at the duodenum just as a large gallstone passed from gall-bladder to bowel (Fig. 5a, b, c). Barium and air are seen in the biliary tree. Subsequent films show that the stone was moving down the small bowel. It was thought that if this stone spontaneously passed into the large bowel, operation would not be necessary. The stone, however, became impacted (Fig. 5d), vomiting became more frequent, and, as a result, laparotomy was carried out and the stone removed from the small bowel. The postoperative course was satisfactory, and two and a half years later the patient has had no further complaints relative to the gastrointestinal tract.



Fig. 4.—Case 4. The bowel pattern suggests small bowel obstruction. There is air in the biliary tree.

That this is a syndrome to be considered in the elderly female patient with findings suggestive of atypical complete or incomplete bowel obstruction is borne out by the final two protocols.

Case 6.-Mrs. M.N. is a 92 year old German woman who has only a nodding acquaintance with the English language. None of her attending physicians is fluent in German, so that details of the history are obscure. However it is sufficient to know that she is 92 and admitted with a six day history of intermittent vomiting and abdominal pain, suggesting an incomplete small bowel obstruction. Her abdomen was slightly distended, with questionable tenderness. There was an incarcerated non-tender mass the size of a small egg in the right femoral ring (a so-called "red her-ring"). A flat film of her abdomen showed dilated small bowel (obstruction or paralytic?) and a right paravertebral calcification (a stone in the renal pelvis?), (Fig. 6). Pulse, respirations, temperature and blood examinations were normal.

The patient was presented at rounds and numerous diagnoses were suggested. However, it was decided that there was sufficient clinical evidence to justify a preoperative diagnosis of gallstone impacted in the jejunum. Her general condition was optimum and would probably

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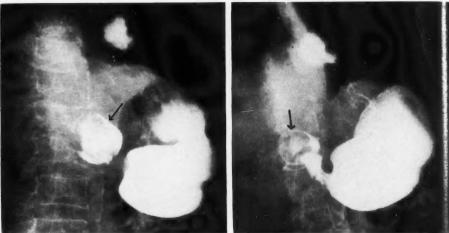


Fig. 5a

Fig. 5b

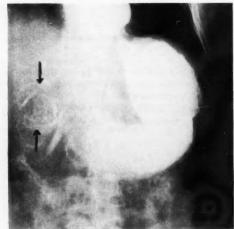


Fig. 5c

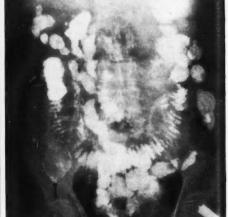


Fig. 5d

Fig. 5a, b, c.—Case 5. A unique set of films showing the passage of a gallstone from the gall-bladder to the duodenum. Fig. 5d.—Case 5. The stone subsequently became impacted in the small bowel.

deteriorate if operation were delayed while awaiting spontaneous passage of the stone. Early operation was undertaken by Dr. N. Alewick and the author, and a large stone was removed from the upper jejunum. A smooth postoperative course followed. The calcification seen in the radiograph was *not* the gallstone.

Case 7.—Since the original presentation of this paper the author has seen another patient (Mrs. L.L.) with this syndrome, and has been impressed further by the need for early

recognition of this condition. In July 1959, a 66 year old woman was treated in hospital for 17 days for abdominal pain and vomiting. Gastric suction corrected the vomiting, but the latter recurred when suction was stopped. Intravenous fluids were administered but not of sufficient volume or composition to maintain her protein and electrolyte balance. Induction of an anæsthetic for exploratory laparotory led to cardio-circulatory collapse and the operation was cancelled.

Careful enquiry into her past history disclosed the digestive disturbances that one associates with gall-bladder malfunction. Review of repeated abdominal films left little doubt that the patient had a mechanical small bwel obstruction and one small gas shadow in the hepatic region suggested air in the bliary tree to the author.

When it had been decided that her general condition was as good as one could expect, laparotomy was performed, and a large stone removed from the distal ileum. However, card ac standstill occurred. (There was evidence of coronary atherosclerosis on previous electrocardiograms). Cardiac massage was done transthoracically but the patient failed to regain consciousness, dying one and a half hours after

operation.

Had the attending physician been aware of the existence of the syndrome of gallstone ileus, and interpreted the clinical and radiographic findings with this diagnosis as a considered possibility, operation could have been performed two weeks earlier, probably with a successful outcome.

#### DISCUSSION

In the past three and one-half years the author has attended four patients with gallstone ileus. In the first case failure to make a correct diagnosis where one could have been made, led to an increased interest in this syndrome. Subsequently three other patients were seen in whom a correct preoperative diagnosis was possible when all the available facts were considered in proper perspective.

One should suspect the diagnosis of gallstone ileus in an elderly female who may or may not give a digestive history suggesting "gall-bladder disease", who presents herself with the clinical picture of "incomplete small bowel obsctruction". The onset is characterized by vague abdominal discomfort, perhaps more pronounced in the right upper quadrant, with accompanying anorexia or nausea. This may persist for several days (Case 5) or weeks (Case 1). Probably at this time there is a low-grade cholecystitis when the large calculus is eroding through gall-bladder and bowel walls. Vomiting begins. At first some, and eventually all, oral intake is returned.

Systemic signs may be remarkably mild initially. Fever is uncommon. The signs



Fig. 6.—Case 6. There is dilatation of small bowel, a calculus in the right kidney and many areas of calcification, none of which were produced by the stone which in this case is not shown.

of impending shock that one finds in obstruction high in the small bowel due to volvulus or vascular impairment are absent. Abdominal examination may reveal nothing more than slight distension. Laboratory findings are equivocal. It is here that "search" films of the abdomen may reveal the diagnostic clue. Certainly no harm can result from such an investigation in the elderly patient, and the diagnostician may be richly rewarded by its frequent use. Radiographs should always be taken with the patient in both recumbent and upright positions, care being taken to show the entire abdomen from diaphragm to perineum. The following findings may be present:

- Gas and/or fluid in dilated small bowel with little or no gas in the large bowel.
- 2. A radio-opaque shadow, usually several centimetres in diameter, suggestive of a gallstone in other than the right upper quadrant, with or without other stones in the gall-bladder area.
- 3. Radiolucent shadows in the hepatic region outlining the biliary tree, which are practically diagnostic of a fistula between

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gall-bladder (or common bile duct) and the gastrointestinal tract. Barium may fill the duct if given orally.

The diagnosis having been established, clinical judgment determines how long one may continue with non-operative management. As in Case 2 the stone may move into the large bowel and be passed per anum or removed digitally. This would seem to be an infrequent event, and early operation should be carried out as soon as the patient's general condition permits. The operator should remove the stone from the bowel and should disregard the gall-bladder and fistula. Whether cholecystectomy should be performed three months later will depend on the assessment of the patient's condition, and on whether cholecystograms show persistent stones in the gall-bladder or fistula.

# CONCLUSION

Let it be emphasized that this diagnosis be considered in the elderly female with incomplete small bowel obstruction. Early diagnosis leads to early, adequate and rewarding therapy; delay is accompanied by a high mortality rate in the ancient age group. There can be no question that a desperately ill grandmother is more than entitled to an early return to her accustomed rocking chair before the flickering TV.

# SUMMARY

An attempt has been made by means of case illustrations to remind the reader of the syndrome of gallstone ileus, that this diagnosis should be considered in the elderly female with small bowel obstruction, and that minimal conservative management be replaced by early surgical intervention.

The author appreciates the permission received from Dr. John Maus (Case 2), Dr. John Kelly (Case 3) and Dr. J. S. Young (Case 4) for use of their patients' protocols in this presentation.

# RÉSUMÉ

L'auteur présente les résumés de sept histoires de cas.

Le premier est celui d'une femme de 81 ans, n'ayant jamais souffert de maladies graves. Six jours avant son admission à l'hôpital, elle fut atteinte de nausées, de vomissements et d'obstruction intestinale. Un film de l'abdomen à vide fut fait, senblant montrer une obstruction du gros intestin : cette impression fut renforcée par le lavement : baryté qui fut arrêté à la courbure splénique, ce sorte que l'on crut à un néoplasme occlusif cu côlon transverse. A l'intervention, on trouva un calcul biliaire enclavé dans la région moyenne ce l'iléon.

Deuxième cas.—Une femme de 76 ans avait subi 12 ans auparavant une résection abdomino-périnéale pour cancer du rectum. On savait de plus qu'elle faisait de la lithiase biliaire; un syndron e d'occlusion s'installa soudainement, mais ici e calcul était visible sur la radiographie à vide de l'abdomen. Le traitement put être conservateur on se contenta de laisser progresser ce calcul e long du tractus intestinal en vérifiant son cheminement par des radiographies répétées. Il fut expulsé trois jours plus tard.

Troisième cas.—Une femme de 66 ans qui avait un long passé de calculose biliaire présenta un syndrome de subocclusion, bientôt suivi d'obstruction totale. Un gros calcul était visible dans le quadrant inférieur gauche sur le film radiographique pris à vide; une laparotomie permit d'enlever cette pierre située dans l'iléon supérieur. Quatre ans plus tard on pratiqua un cholécystec-

Le quatrième cas est celui d'une femme de 80 ans, chez qui on avait diagnostiqué un état lithiasique remontant à environ six ans plus tôt. Des coliques apparurent, rapidement suivies d'une obstruction totale. Un diagnostic pré-opératoire correct fut posé: celui de fistule cholécysto-duodénale avec iléus par calcul biliaire; l'intervention adéquate fut pratiquée et la malade guérit sans autre histoire.

Dans le cinquième cas (celui d'une femme de 86 ans) des symptômes de nausées et de vomissements étaient apparus une quinzaine de jours avant l'admission motivée par la gravité des vomissements. L'examen radiologique fut ici particulièrement démonstratif. Une laparotomie permit de procéder à l'ablation d'un calcul biliaire enclavé dans l'intestin grêle.

Sixième cas.—Une femme de 92 ans, souffrait de subocclusion depuis six jours. Une radiographie à vide montrait des anses dilatées, correspondant à un syndrome d'iléus du grêle, ainsi qu'une calcification paravertébrale droite. On décida une exploration qui mit à jour un gros calcul biliaire enclavé dans le jéjunum; on en fit l'ablation. A noter que la calcification aperçue sur le cliché ne correspondait pas à ce calcul.

Septième cas.—Une femme de 66 ans présentait un ensemble de symptômes d'obstruction dont le diagnostic fut particulièrement difficile. A la laparotomie, il fut découvert et extrait un calcul situé dans l'iléon terminal; la malade avait un très mauvais état général et ne supporta pas cette opération.

De l'ensemble de ces cas, on peut tirer les conclusions suivantes qui permettront d'orienter e diagnostic dans la direction correcte: l'anamnèse re signifie que peu de chose; la lithiase biliaire doit être soupçonnée chez toute malade âgée présentat ou non un passé hépatique. La fièvre est raremer télevée. L'état de choc est peu marqué; l'exame a abdominal ne montre rien de plus qu'une distension généralisée. L'examen radiologique à vide peu présenter les images les plus variables, mais l'audra toujours y chercher l'ombre ou les ombres de calculs ainsi que la présence de gaz dans l'arbre biliaire.

# RADIAL HEAD PROSTHESIS IN THE MANAGEMENT OF RADIAL HEAD FRACTURES°

G. E. EDWARDS, M.D. and O. ROSTRUP, M.D., F.R.C.S.[C], F.A.C.S.,† Edmonton, Alta.

FRACTURES of the head of the radius constitute some 30% of all fractures and dislocations of the elbow.<sup>3</sup>

Comminuted fractures of the radial head in adults are treated by excision of the radial head, but the results of this treatment have not been uniformly successful. Cherry<sup>1, 2</sup> described the substitution of an arrylic prosthesis in the treatment of fractures of the radial head requiring excision. It is intended to prevent the proximal migration of the radial shaft and the consequent subluxation of the distal radio-ulnar joint.

The cases presented in this paper represent the fractures of the radial head in adults treated by operation in the teaching hospitals of the University of Alberta from August 1950 to August 1958. We have compared the results obtained in the group in which the radial head was excised with those in the group of radial head fractures treated by replacement of the radial head with a prosthesis.

#### CLINICAL STUDY

Of the 47 cases of radial head fracture in adults in this series, 14 were lost to follow-up. The remaining 33 patients answered the questionnaire; 18 had had prostheses inserted and 11 of these were personally examined by the author (G.E.E.); 15 had had simple radial head excisions and seven of these were examined by the author (G.E.E.). Those who were not examined replied on their questionnaire that they were having no difficulty with their elbow or wrist and had returned to their former employment. We are recording the follow-up only on those with simple comminuted radial head fractures, 14 treated with prostheses and 11 by excision alone. The remaining eight cases were of the Monteggia type fracture-dislocation.

The average age of the group treated by radial head prosthesis was 38 years, and they consisted of six males and eight females. The average age of those treated by excision alone was 35 years, and this group comprised 10 males and one female.

The follow-up period in the group with a prosthesis ranged from nine months to seven years and one month, with an average follow-up of three and a half years.

All patients were operated upon within seven days of the injury. There were no immediate postoperative complications in either group.

Of the 14 patients in the radial head prosthesis group, 11 (79%) have no pain and three (21%) have minimal pain in the elbow. Twelve (86%) report no loss of movement of the arm, while two (14%) have some loss of movement at the elbow.

Of the 11 patients in the radial head excision group, five (45%) have no pain, three (27%) have pain at the elbow, one (9%) has pain at the wrist and two (18%) have pain at both wrist and elbow. Seven patients (64%) have no loss of movement, three (27%) have some loss of movement at the elbow and one (9%) has loss of movement at the wrist.

The average time for return to full employment after operation was nine and a half weeks in the radial head prosthesis group and  $12\frac{1}{2}$  weeks in the radial head excision group.

Of the patients with a radial head prosthesis 11 (79%) said they could work as well after the accident as before, whereas three (21%) stated that they could not. Of those with excision only, six (55%) could work as well after operation and five (45%) could not.

The patient's evaluation of the operation of radial head substitution was excellent in eight (57%) cases, good in four (29%) cases and poor in two (14%). The latter two were cases in which the metallic stem had broken off the acrylic head and had to be removed owing to elbow pain. Four (37%) patients thought the results of radial

<sup>&</sup>lt;sup>o</sup>This work was supported by a Medical Research Grant, University of Alberta.

<sup>†</sup>Department of Surgery, University of Alberta.

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TABLE I.

	Simple radial head excision	Radial head prosthesis
Pain:		
No pain	45%	79%
Elbow pain	27%	21%
Wrist pain	9%	0%
Elbow and wrist pain	- 70	- , 0
combined	19%	0%
Loss of movement:		7.0
No loss of movement	64%	86%
Loss of movement at elbow	27%	14%
Loss of movement at wrist	9%	0%

head excision excellent, four (37%) good, one (9%) fair and two (18%) poor.

In the group treated by radial head excision alone there are two (18%) cases of subluxation of the inferior radio-ulnar joint. One of them, in a 23 year old man, occurred approximately eight months post-operatively and was treated by excision of the distal end of the ulna. There was a third case in the group of Monteggia fracture-dislocations which have not been included in this study.

# DISCUSSION

There has been much controversy whether or not a radial head prosthesis should be used in uncomplicated comminuted fractures of the radial head in adults.

Watson-Jones<sup>5</sup> believes that the operation is indicated in the rare but definite cases in which fracture of the radial head is associated with rupture of the interosseous membrane and marked upward displacement of the radius.

Jeffery<sup>6</sup> stated that he was unable to find one case of inferior radio-ulnar subluxation in a large group of patients in whom the radial head had been excised.

TABLE II.

	Simple radial head excision	Radial head prosthesi
Patients' evaluation of operatio	n:	
Excellent	37%	57%
Good	37%	29%
Fair	9%	14%
Poor	18%	0%
Able to work as well after	55%	79%

McDougall\* reported 25 cases of inferior radio-ulnar subluxation in 100 cases of fracture of the radial head, of which five we're severe displacements. He believes that the interosseous membrane need not be torn of allow the upward displacement of the radius. He states that the amount of strain to which the forearm is subjected, the muscular pull upon the forearm, and the amount of radial head and neck resected all inflaence the degree and rapidity of the upward displacement.

Admittedly the present series is a small one and the follow-up period is at present short, but there are two examples of inferior radio-ulnar subluxation in the 11 cases treated by simple radial head excision alone, whereas there were no cases among the 14 treated with a radial head prosthesis.

We have had two cases of fracture of the acrylic prosthesis, which had to be eventually removed. In the last two cases we have used an entirely metallic prosthesis.

We use the simple lateral Kocher incision both for insertion of the prosthesis and for simple excision of the head.

#### CONCLUSIONS

This very small series shows no greater immediate postoperative morbidity from substitution of a prosthesis than from simple radial head excision. No patient with prosthetic replacement had wrist pain, whereas three did in the simple excision group.

Despite the short follow-up period in this small series, we feel that radial head substitution has some place in the prevention of distal radio-ulnar subluxation after radial head excision.

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#### RÉSUMÉ

Les fractures comminutives de la tête radiale clez l'adulte sont traitées par excision de la tête; er 1953, Cherry a proposé le remplacement de cate tête par une prothèse en matière acrylique. L présent article donne des résultats comparatifs er tre les deux méthodes. Quatorze malades furent trités par excision suivie de mise en place d'une pi othèse, et onze par excision simple.

Dans le groupe des résections simples, 45% n'ont aucune douleur; 27% se plaignent d'une douleur au coude; 9% accusent une douleur au poignet, et 19% au coude et au poignet. Le temps d'incapacité a été en moyenne de 12½ semaines.

En ce qui concerne les résections suivies de remplacement prothétique: 79% ne présentent plus aucune douleur; 21% accusent une légère douleur dans le coude. Le temps moyen d'incapacité fut ici réduit à 9½ semaines.

Dans aucun cas il n'a été observé de complication post-opératoire grave. En dépit du petit nombre de cas sur lequel est basée cette statistique, les auteurs pensent que la mise en place d'une prothèse radiale est une intervention d'avenir en chirurgie du poignet.

# LES PLASTIES ALLOGENES DANS LA CHIRURGIE DES OS ET DES ARTICULATIONS°

"Dans tous les domaines de la chirurgie, sont de plus en plus employés les corps étrangers en remplacement de tissus humains malades ou perdus pour une raison ou une autre. Je rappellerai le traitement des grosses hernies par des filets métalliques ou en matière synthétique, le pontage de l'œsophage, de la trachée et surtout des vaisseaux par des prothèses en matériel inerte.

La chirurgie osseuse et articulaire a depuis fort longtemps utilisé du matériel inerte dans le but de protéger, de soutenir, de diriger ou d'aider au fonctionnement. Ce matériel était adapté à la taille et à la forme. Depuis longtemps on a cherché à obtenir une bonne adaption du corps étranger au tissu osseux, mais des progrès sensibles n'ont été enregistrés qu'avec l'apparition de la chirurgie aseptique.

A côté de différents métaux tels que le laiton, le bronze, le magnésium, les alliages légers, l'argent, l'or et le fer ou l'acier nickelé ou chromé, on a utilisé le bois, l'ambre, la corne, l'ivoire, le celluloïde, la corne synthétique, etc. Une bonne partie de ces corps étrangers était supportée sans incident, plus ou moins longtemps, puis ils étaient éliminés au cours d'accidents inflammatoires, ou de-

vaient être enlevés pour une raison quelconque.

Le sort de ces corps étrangers ne dépend qu'en partie de la tolérance tissulaire. Leur capacité fonctionnelle et l'effort mécanique demandé aux tissus mous jouent un rôle encore plus grand dans le maintien du corps étranger. Ceci reste valable pour les métaux nobles apparus plus récemment et pour les résines synthétiques bien qu'ils ne provoquent qu'une réaction négligeable ou même nulle, tout au moins au début ou dans les premières années.

Selon leur stabilité qui peut être mesurée mécaniquement, physiquement et chimiquement, ils seront admis par les tissus corporels et rempliront leurs fonctions, ou seront éliminés souvent avec des réactions très douloureuses; leur ablation devient finalement nécessaire bien qu'ils aient remplis leur devoir de protection, de soutien et de fonctionnement.

Qu'il s'agisse de matériel métallique ou synthétique, nous devons étudier séparément les altérations subies par le corps étranger dans sa texture et les lésions cellulaires qu'il provoque dans les tissus humains. Les réactions cellulaires ne surviennent souvent qu'une fois la prothèse brisée, déteriorée ou détachée. Le tissu vivant et le matériel inerte réagissent l'un sur l'autre.

Tout matériel inerte placé, dans un os ou une articulation, entre deux os provoque un effet mécanique, un effet biologique, un effet chimique et un effet physio-chimique ainsi que l'a démontré en 1947 pour les métaux R. Nicole dans son travail si riche en conclusions."

<sup>&</sup>lt;sup>o</sup>Buerkle de la Campe, H.: Lyon chir., **55**: 641, 1959.

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# THROMBOSE MESENTERIQUE ET CARCINOIDE DU GRELE°

EDOUARD DESJARDINS, F.R.C.S.[C],† LOUIS BEAUDOIN, F.R.C.S.[C],‡ ROGER GAREAU§ et ALBERT ALLARD,¶ Montréal

La thrombose mésentérique pose de moins en moins de problèmes. Le diagnostic demeure difficile; le pronostic est encore sombre, mais la pathologie et le traitement chirurgical marquent un progrès réel.

L'étiologie se clarifie à la lueur des travaux récents; aux causes connues comme les lésions cardio-vasculaires et les infections abdominales s'ajoute l'origine tumorale, <sup>3-6</sup> objet de cette publication. La tactique opératoire offre de nouvelles ressources, car l'embolectomie et l'endartériectomie se substituent parfois à la résection intestinale classique. Les résultats heureux sont en relation directe de la précocité du diagnostic.

La thrombose mésentérique est rare; nous en avons relevé toutefois 37 cas de 1950 à 1957. L'étude de ces observations nous a paru susceptible d'intérêt et nous en reproduisons les chiffres, à la faveur d'un cas récent secondaire à un carcinoïde du grêle.

L'histoire de ce dernier malade paraît démonstrative.

E.B., 61 ans, entre le 29 avril 1958 à l'Hôtel-Dieu pour un syndrome abdominal douloureux. La douleur abdominale, apparue 15 mois auparavant comme un simple malaise après les repas, s'accentue et s'accompagne de vomissements et de lipothymies.

L'examen radiologique digestif, pratiqué le 8 mai, montre une infiltration de l'iléon terminal et des images lacunaires au cæcum donnant l'impression d'un processus inflammatoire ou tumoral au voisinage de l'angle iléo-cæcal.

La persistance de la douleur, l'amaigrissement, les constations radiologiques et l'échec de la thérapeutique médicale imposent la sanction chirurgicale. L'opération a lieu le 13 mai; un peu d'ascite s'écoule à l'ouverture du péritoine, le cœcum et l'appendice se montrent de coloration anormale, légèrement cyanotique, sans augmentation de volume, ni masse. A quelques centimètres de l'angle iléo-cæc il, dans le mésentère, on découvre un nodule le deux centimètres de diamètre, semblant fa re corps avec l'iléon. La biopsie montre qu'il s'agit d'un carcinoïde du grêle. Le mésentère est envahi de proche en proche par un carcinoïde typique (Fig. 1).

L'état du malade ne permet que cette seu le biopsie, suivie au cinquième jour, d'un iléus, nécessitant la seconde intervention qui a lieu le 24 mai. Dès l'ouverture du péritoine, surgit un liquide purulent; les anses grêles sont nécrosées et perforées en plusieurs endroits. L'opération consiste en une résection d'environ 125 centimètres qui comprend l'iléon terminal, le cœcum, l'appendice et une partie du côlon ascendant et qui est suivie d'une anastomose bout à bout.

Le péritoine iléal est épaissi, cicatriciel et blanchâtre dans une région où la lumière est particulièrement dilatée (Fig. 2). A cet endroit, il existe un rétrécissement annulaire au niveau duquel on palpe une petite tumeur située près de l'insertion mésentérique. Cette tumeur ressemble à un polype sessile d'un centimètre de diamètre par 0.18 centimètre de hauteur; son extrémité est lisse.

Au niveau du mésentère, on palpe une induration qui correspond à l'envahissement tumoral. La muqueuse qui recouvre la tumeur est ulcérée; il existe une dilatation extrême des grosses veines de la sous-muqueuse, de même que des petites veines et des capillaires de toutes les coupes de la paroi intestinale, certaines veines étant obstruées par des thrombi plutôt récents. Au niveau du mésentère, quelques veines sont thrombosées avec début d'organisation du thrombus; les artères sont encore perméables, sauf de très rares exceptions qui sont thrombosées à la suite de la nécrese de leur paroi. Dans certaines régions du mésentère, de petits îlots de carcinoïde sent reconnaissables (Fig. 3).

Cette tumeur est un carcinoïde malin le l'iléon avec métastases aux ganglions régiona ix et avec envahissement direct du mésentè e. L'iléon et la tumeur sont infarcis par thrombose des veines mésentériques. Fait à noter, les 19 et 25 mai 1958, la recherche spécifique lu métabolite urinaire du carcinoïde, soit l'acide 5 hydroxy-indol-acétique, est entièrement négative. L'examen radiologique du grêle montre une bonne perméabilité de toutes les ans es

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33 jours après la résection; le transit s'effectue rapidement et assure de façon précoce l'opacification de la bouche d'anastomose. La bouche an stomotique est large et indemne de toute lés on.

Le 3 juillet, soit 40 jours après l'opération, le nalade quitte l'Hôtel-Dieu pour entrer dans un hôpital de convalescents, où il décède sul itement le 14 juillet 1958, de cause inconue; il n'y eut pas d'autopsie.

Les cas de thrombose mésentérique survenus dans le service de chirurgie de l'Hôtel-Dieu de Montréal de 1950 à 1957 inclusivement sont au nombre de 37; 19 cas ont été opérés, quatre ont eu un traitement médical sans contrôle par laparotomie et 14 furent une trouvaille d'autopsie.

La thrombose mésentérique est connue sous de nombreux synonymes. Sullivan<sup>17</sup> par le de "mesenteric vascular inadequacy" et Pratt<sup>13</sup> de manifestations viscérales de la maladie occlusive des vaisseaux sanguins intestinaux. En somme, quelle que soit la terminologie, il s'agit d'un trouble de la circulation mésentérique, primitif ou secondaire, permanent ou passager. L'infarctus intestinal est l'envahissement de l'intestin et de son mésentère par le sang extravasé, issu soudain des capillaires et diffusant dans les diverses couches de l'intestin.

La maladie est rare; selon Uricchio, 18 on en a retracé 19 cas sur 55,232 admissions à Truro Infirmary, 51 cas sur 369,195 au Boston City Hospital, et 13 cas sur 57,380 au Massachusetts General Hospital. Chez Mayo, Musgrove<sup>11,16</sup> en a trouvé 60 cas avant 1938 et, de 1939 à 1948, 24 cas. Les 37 cas compilés à l'Hôtel-Dieu en huit ans confirment la règle générale de la fréquence restreinte. L'âge de nos malades est variable comme ailleurs (Tableau IV). La répartition des cas selon le sexe montre une légère prédominance chez l'homme.

Les malades atteints sont des cardiaques, des artério-scléreux, des cirrhotiques, des phlébitiques, des infectés abdominaux et des vasculaires (Tableau II).

La thrombose mésentérique est due à une oblitération vasculaire, à un spasme sans lésion vasculaire apparente ou à un choc anaphylactique d'intolérance. Quatre cas de la série apparaissent dans la colonne des cas non opérés et guéris médicalement (Tableau I); ils sont vraisemblablement la



Fig. 1.—Iléon dilaté. Mésentère épaissi et envahi. Le carcinoïde est situé au niveau de la dépression centrale. Matériel fixé au formol.



Fig. 2.—Section longitudinale de l'iléon au niveau du carcinoïde. Présence de foyers tumoraux au niveau des plis muqueux voisins de la tumeur principale.

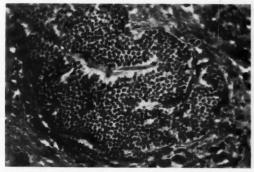


Fig. 3.—Biopsie de la métastase péritonéale. Carcinoïde typique. Structure cordonale. Noyaux de même dimension. Absence de mitoses. Hémalunphloxine-safran x 192.

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TABLEAU I.—Cas Observés à l'Hôtel-Dieu

Année	1950	1951	1952	1953	1954	1955	1956	190
No. de Cas	3	1	2	4	5	10	6	6
Hommes	2	1	1	2	2	7	2	4
Femmes	1		1	2	3	3	4	2
Opérés	2		1	2	1	5	3	5
Opérés guéris	2		1			3	1	2
Traités médicalement	-				1	3		
Décédés	2	1	1	4	4	4	5	4
Autopsie	2	î	1	2	4	3	5	1

#### TABLEAU II.

Antécédents													No. de co
Thrombose													23
Lésions cardiaques			į		Ü	ì							21
Diabète		Ī	Ĵ	î			Û	ì			ĺ	ì	3
Buerger													2
Athéromatose artérielle													5
Artério-sclérose													7
Rétrécissement mitral.													2
Syphilis	i						į.						2

#### TABLEAU III.

Diagnostic à l'admission	No. de co
Thrombose mésentérique: positive	7
Thrombose mésentérique: possible	11
Occlusion intestinale	10
Appendicite aiguë	9
Pancréatite aiguë	9
Ulcère perforé	8
Cholécystite aiguë	6
Thrombose coronaire	4
Diverticulite	3
Entérite	
Hémorragie digestive	2
Hémopéritoine	2
Lithiase rénale	2

# TABLEAU IV.

Cas de l'H	lôtel-Dieu		Cas de Gordin et Lauren					
Nombre		Age	Nombre					
1	1	10-20	0	0				
0	0	21-30	1	1				
1	1	31-40	3	0				
5	2	41-50	2	1				
7	1	51-60	1	0				
2	1	61-70	3	0				
3	2	71-80	4	1				
19	8		14	3				

conséquence d'un spasme ou d'un choc anaphylactique. Par contre les 33 autres cas relèvent bien d'une occlusion vas ulaire, artérielle, veineuse ou mixte, artérielle et veineuse.

Les causes de l'oblitération vasculaire artério-mésentérique supérieure sont multiples. Artérielle, l'occlusion peut être due à une embolie venant du cœur (insuffisance mitrale, aortique, endocardite, infarctus myocardique), des artères (anévrysme de l'aorte, Buerger, artérite, athérome aortique) ou d'une végétation d'un canal artériel. Veineuse, l'oblitération peut être tronculaire (splénomégalie, stase portale) ou radiculaire (infections abdominales, génitales, appendicite, entérite, pelvipéritonite, hémorroïdes, phlébite). Mixte, l'oblitération est causée soit par un volvulus, soit par une tumeur; ce qui fut le cas du carcinoïde du grêle.

L'évolution clinique de la thrombose mésentérique est en raison directe de la nature des vaisseaux atteints. Les signes sont marqués et subits dans l'occlusion artérielle; ils s'aggravent rapidement et le tableau s'assombrit dès le début; les symptômes sont plus lents à apparaître et ils sont plus discrets dans l'oblitération veineuse, où l'atteinte à l'état général est tardive.

Les signes habituels sont la douleur atroce dans l'atteinte artérielle, l'état de choc, les nausées et vomissements, le sang dans les selles, la diarrhée ou l'iléus, tous présents chez nos malades.

La formule blanche a été orientée duns le sens d'une augmentation des leucocytes avec polynucléose; la formule rouge a montré dans 16 cas une hausse de l'hérnoglobine et dans 14 cas une élévation de l'hématocrite. Dans 27 cas on a trouvé une hyperleucocytose à 12,000 globules blancs ou plus avec polynucléose à 80% ou plus. La radiologie n'apporte au diagnostic de

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la thrombose mésentérique qu'un secours relatif: aéro-hydro-iléie segmentaire ou généralisée.

Le diagnostic clinique est difficile, car l'histoire est souvent vague et les signes objectifs peu marqués. Seule la connaissance des antécédents pathologiques oriente ve's une atteinte vasculaire abdominale.

Sept de nos malades ont été opérés sur la foi d'un diagnostic positif; 11 autres ont doané lieu à cette impression à titre de possibilité et 19 cas ont porté vers des conjectures variables (Tableau III). Le diagno tic est souvent une trouvaille opératoire ou une découverte d'autopsie. Dans notre série, 19 cas ont été confirmés par l'opération et 14 par l'autopsie.

Le pronostic de la thrombose mésentérique est très sombre; les uns disent qu'il est fatal dans 32% des cas, d'autres, dans 84%. Si l'on prend le chiffre moyen, on arrive à 62% de décès. De nos 37 malades, 25 sont morts (Tableau I).

Le traitement est chirurgical et il varie entre la laparotomie simple et la résection intestinale. Cinq malades ont subi une laparotomie simple: quatre décès, une guérison; 14 ont eu une résection intestinale: sept décès, sept guérisons; deux malades sont morts à la salle d'opération, au début de l'anesthésie: l'un d'arrêt cardiaque et l'autre de chute de la tension artérielle. La concordance des résultats apparaît au Tableau IV. L'évolution chirurgicale enseigne que la résection intestinale doit faire place, quand il y a indication, à l'embolectomie et à l'endartériectomie.8.9 Aucun de nos cas n'a été soumis à l'embolectomie.

En conclusion, la thrombose mésentérique demeure une maladie grave. A sa pathogénie connue, il faut ajouter l'origine tumorale. Le diagnostic est difficile, malgré l'allure dramatique et les signes subjectifs marqués, car il y a une paucité relative de signes objectifs. Seules parfois, les antécédents pathologiques orientent le diagnostic. La thérapeutique opératoire, même si elle s'inspire des techniques nouvelles, n'est efficace qu'au prix de sa précocité.

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#### SUMMARY

Although diagnosis of mesenteric thrombosis is difficult and the prognosis is still grave, advances have recently been made in treatment. It is a rare lesion, for the authors have found only 37 cases in 8 years. One of the causes is intestinal tumour, and the case reported here was secondary to a carcinoid of the small intestine.

A 61-year-old man was admitted with abdominal pain, which had been gradually increasing for 15 months and was accompanied by vomiting and faintness. Radiography showed an infiltration of the terminal ileum and cæcal lesions giving the impression of an inflammatory or neoplastic process. At operation, the cæcum and appendix were somewhat cyanotic and a few centimetres from

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the ileo-cæcal angle in the mesentery there was a small carcinoid. The patient's condition permitted only a biopsy, but at a second operation eleven days later the peritoneal cavity was full of pus with necrosis and perforation of small intestine. About 1.25 m. of intestine (terminal ileum, cæcum, appendix and part of the ascending colon) was resected and anastomosed end to end. Examination of the resected specimen showed a malignant carcinoid of the ileum with metastases to regional lymph nodes and direct invasion of the mesentery. Ileum and tumour were infarcted, with thrombosis of mesenteric veins. Studies of the urine for 5-hydroxyindolacetic acid were negative. Subsequent radiography showed a satisfactory state of the intestine, but less than two months after operation the patient died, cause unknown.

The authors review the 37 cases seen at the Hôtel-Dieu de Montréal between 1950 and 1957.

The authors review the 37 cases seen at the Hôtel-Dieu de Montréal between 1950 and 1957. Nineteen were operated on, 4 had medical treatment and 14 were undiagnosed until autopsy. The age distribution is wide, and slightly more men than women are affected. In 23 cases there was a previous history of thrombosis and in 21 of cardiac lesions; 3 patients had diabetes, 2 Buerger's disease, and another 12 arterial lesions. The 4

patients who got better with medical treatr ent had suffered from vascular spasm or anaphylectic shock. The 33 other patients had some forn of vascular occlusion. Such an occlusion may a ect the arteries, veins or both. The signs are obvous and early in arterial occlusion, more insidious and slow to appear in venous occlusion. The unal symptoms and signs include great pain, shock, nausea and vomiting, blood in the stools, diarroca or ileus. The white cell count usually shovs a leucocytosis, sometimes with increase in hænoglobin value and hæmatocrit value. Radiological examination is not too helpful in diagnosis, but may show ileus with fluid and gas levels.

Seven of the patients in the present series vere operated on with a definite diagnosis, 11 others with a possible diagnosis and 19 with no definite diagnosis. Mortality figures vary according to the author from 32% to 84%. Out of the present 37 patients, 25 are dead.

Treatment is surgical and varies from laparotomy to intestinal resection. Out of the 14 cases resected, 7 were cured. A recent development is the substitution of embolectomy or endarteriectomy for intestinal resection; no operations of this nature figure in the present series.

# SURGICAL JUDGMENT\*

In a surgeon there is no quality of mind more to be desired than that of judgment. Judgment is the product of a mind cultured by a liberal and professional education and matured by experience. It is judgment even more than skill that makes a truly successful surgeon.

Judgment is not really developed during under-graduate training when the academic foundations are being laid. In the comparatively short period of under-graduate training, the student is required to absorb a mass of accepted knowledge, presented to him with a dogmatism characteristic of under-graduate teaching. There is too little time for explanations which would enable him to assimilate it on a basis of physiology and pathology. The intensive teaching dulls any imagination he may have; and the result is that if he is to be academically successful he must form memorizing rather than reasoning habits of mind. Thus, though he may acquire much knowledge, he develops little wisdom and lays no foundation in the art of acquiring wisdom.

As time goes on, however, the developing surgeon begins to exchange his memorizing for reasoning habits of mind. In this way he begins to accumulate that mature wisdom and develop that sound judgment which is so essential in the make-up of a surgeon. He is encouraged in this as he comes under the influence of those who have attained a position in the profession which entitles them to hand on the torch of knowledge and to point the way of wisdom and judgment. The young surgeon becomes sensible of this influence first in the hospital wards, operating theatres, and laboratories, then at surgical conferences, and laboratories, then at surgical conferences, and inally through the medium of surgical literature, in relation to which he must cultivate a kindly critical mind.

Chastened by his experiences, enlightened by his scientific association, and encouraged by the counsels of his seniors, he develops a changing point of view. He begins to lose his rigidity of mind, to rely less on text books and more on his own observations, to have doubts, to develop an open mind, and above all to acquire a humility of thought-perhaps the greatest sign of wisdom. And then naturally comes an assessment of the clinical value of his experiences; an examination of surgical procedures in the light of his developing judgment; an accumulation and assortment of these for comparison with others of a like nature in the future. Then follow speculations, inferences and hypotheses; the testing of these by fur her observations; and finally theories and discoveries. All these are milestones in the cultivated march of surgical judgment. If now Nature has been kind to him and his Chris ian and vocational roots lie deep, the end result should be the ideal surgeon.

<sup>\*</sup>Sir Hugh Devine, Australian and New Zealand I. Surg., 20: 161, 1950.

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# TORSION OF THE OVARIAN PEDICLE

C. A. DOUGLAS RINGROSE, M.D., e Edmonton, Alta.

Torsion of the ovarian pedicle is an uncommon accident. In the course of 13,831 admissions to the gynæcology service of Detroit Receiving Hospital from 1949 to 19-8, there were only seven cases.

Reports in the literature indicate that to sion can occur at any age from for months to the postmenopausal period. 5,6,8,10-12,14 The patients in this study ranged in age from 14 to 33 years.

Robins<sup>9</sup> reported two cases that occurred in the last trimester of pregnancy. Three of our patients were pregnant at six, seven and 14 weeks' gestation (Cases 3, 2, and 1 in Table I) when the accident occurred. Of the non-pregnant group, two patients were menstruating, one was in the 18th day of her cycle, and the other was having irregular bleeding due to thrombocytopenia. Smith and Butler<sup>13</sup> have reported that a large percentage of torsions occur in close relation to the menstrual period. Cases have been reported, however, in all phases of the cycle.<sup>3,7</sup>

# Symptoms

Pain of sudden onset, severe in quality, progressive in nature, and located initially in the region of the torsion was the rule. Radiation to the flank and thigh on the same side was common.<sup>5,14</sup> (Cases 2, 5 and 6, Table I). Nausea and vomiting were invariably present.

# Past History and Possible Etiological Factors

The past history revealed that two patients had undergone tubal ligation, one had a bilateral salpingectomy and one an inguinal herniorrhaphy on the involved side before the episode of torsion. This would suggest that alteration of the pelvic anatomy may have promoted torsion. Many theories have been put forward to explain the etiological mechanism. Auvray, quoted

by Manos,6 stated that the spiral course of the tube, normally present in fetal life, may persist as a congenital anomaly in a child and be a predisposing factor. A long mesosalpinx<sup>1</sup> is reported to favour the accident. Payr's theory that congestion of veins in a pedicle favours a spiral course and torsion has been widely quoted.1,13 Once the twist has started, the pulsation of the arteries may encourage progression.2 Sellheim's theory is that sudden changes of body movement may give rise to torsion. This mechanism may explain the onset during intercourse in Case 5 (Table I). Disturbances in normal tubal peristalsis and tubal spasm have also been suggested as predisposing factors.1

# PHYSICAL FINDINGS

Physical examination revealed acute distress, usually with normal vital signs. As the disorder persisted, a low grade fever and signs of peritoneal irritation developed. Pelvic examination was frequently difficult owing to the voluntary guarding, but demonstrated a tender adnexal mass in all our cases. Culdocentesis was a valuable aid and vielded dark red fluid in five instances (Cases 3, 4, 5, 6, 7, Table I). In Case 5, the initial tap four hours after onset of symptoms yielded yellow, serous fluid. At twelve hours, however, the fluid was serosanguineous. This fluid exudate from the stricken organ is a result of the progressing infarction, as the thin walled veins are occluded relatively early in the torsion but the more rigid arteries continue to conduct blood into the ovary. In Case 2, the only tap was performed early and a pink fluid was obtained. In Case 1, the tap was omitted presumably because the 14-week sized uterus filled the cul de sac.

# LABORATORY AND X-RAY FINDINGS

Most cases had a mild leukocytosis. A plain film of the abdomen showed a pelvic mass in two subjects (Cases 3 and 6).

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TABLE L-SUMMARY OF CASES

No.	General	History	Physical exam.	Laboratory findings	Operative findings	Postoperati e course		
1	14 year old G 1 P 0 14 weeks preg.	Epigastric pain radiating to RLQ—24 hrs. Nausea and vomiting T- 98.6° F P- 100 Tender mass right adnexa. Uterus 14 weeks size		o RLQ-24 hrs. Nausea Tender mass right adnexa. Uterus 14		o RLQ-24 hrs. Nausea Tender mass right adnexa. Uterus 14 mal rig		Delivered at err
2	26 year old G 2 P 1 7 weeks preg.	RLQ pain radiating to flank for 14 hrs. Nausea and vomiting. Loose stools	T- 98.6° F P- 88 Peritoneal irrita- tion RLQ. Tender mass rt. adnexa	WBC- 9800/c.mm. Culdocentesis-pink exudate	Infarcted, tera- toma rt. ovary and tube twisted x 3	Uneventful		
3	28 year old G 7 P 5 Abort. 1 6 weeks preg.	RLQ pain — 24 hrs.—radiates to rectum. Urge to defecate. Nausea and vomiting. Previous right inguinal herniorrhaphy	T- 99.2° P- 100 Tender mass RLQ and right adnexa	WBC- 9900/c.mm. Culdocentesis- serosang. fluid Flat plate of abd pelvic mass	Rt. ovarian cyst twisted with tube. Both infarcted	Aborted 1 vee postoperative y		
4	31 year old G 3 P 2 Abort. 1 Irreg. bl.	2 Abort. shoulder -2 days. D and Tender 4t. adnexal Platelets- eg, bl. C 1 week prev. for irreg. mass. Lower abdo- 15,000/c.mm.		days. D and ev. for irreg. mass. Lower abdoverous right minal tenderness by and bilat.  Tender 4t. adnexal Platelets-15,000/c.mm. Culdocentesis-non-clotting bl.		Thrombocyte penia responder to ACTH		
5	29 year old G3 P 1 Abort. 2 18th day of cycle	Pain LLQ—30 hours. Started during coitus. Radiation to left flank and left inguinal area. Nausea and vomiting. Previous C. section and tubal ligation	T- 99.6° P- 104 Tender mass left adnexa	WBC-7600/c.mm. Culdocentesis- initially serous— later serosanguin- eous	Infarcted.twisted left ovary with distal half of tube	Uneventful		
6	29 year old G 12 P 12 3rd day of cycle	Pain LLQ—17 hrs. with radiation to left flank. Nausea and vomiting. Previous tubal ligation	T- 99° P-76 Tender mass LLQ and left adnexa	WBC-11,800/c.mm. IVP- pelvic mass Culdocentesis- serosang, fluid	Torsion of left tube and tera- toma left ovary with infarction	Uneventful		
7	33 year old G 2 P 2 2nd day of cycle	RLQ pain—18 hours. Nausea and vomiting	T- 99° P- 86 Tenderness RLQ and right adnexa	WBC-13,050/c.mm. Culdocentesis- serosang. fluid	Infarcted right ovarian cyst and and tube	Uneventful		

#### OPERATIVE FINDINGS

An apparently normal ovary was involved on three occasions (Cases 1, 4 and 5). Two of the four abnormal ovaries contained teratomas. In Case 3, the corpus luteum of pregnancy was probably involved since this patient aborted one week postoperatively (at seven weeks' gestation). The remaining case (Case 7) involved an unclassified ovarian cyst.

The left ovary was involved in three cases and the right in four. Anspach found that the incidence was greater on the right in a ratio of 3:2 and postulated that the sigmoid colon afforded less room on the left side for the occurrence of torsion. Sarason and Prior, 10 however, reported five of six cases occurring on the left.

The direction of torsion was not clear in reviewing five of our seven cases. In Cases 5 and 6, both with left-sided involvement, the direction of torsion was medially and posteriorly. This is in defiance of Kustner's law formulated in 1890, and reproduced by Downer and Brines. Kustner's original drawing portrays an anterior and lateral direction on each side as being usual.

#### SUMMARY AND CONCLUSIONS

Torsion of the ovary is uncommon.

The cardinal symptom is pain in the lower abdomen, frequently with radiation to the anterior thigh and flank.

Surgical alteration of the adnexa preceded torsion in four of our seven cases. In one additional subject, symptoms started during intercourse.

Physical examination frequently revealed signs of peritoneal irritation and a tender mass on the involved side. General systemic reaction was minimal. Culdocentesis commonly yielded dark red fluid, like port wine, and was a valuable diagnostic aid.

A pathological adnexa was involved in four instances and a normal ovary in three. Likewise, the right to left ratio was 4:3

Kustner's law was contradicted in the two cases in which the direction of torsion was recorded.

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#### RÉSUMÉ

La torsion de l'ovaire est rare. Son symptôme principal est la douleur dans le bas abdomen souvent avec élancements au flanc et à la face antérieure de la cuisse. Dans quatre cas sur sept la torsion avait été précédée d'une intervention sur l'ovaire ou l'oviducte. Dans un autre cas les symptômes débutèrent au cours d'un rapport sexuel. L'examen révèle souvent des signes d'irritation péritonéale ainsi qu'une masse sensible du côté intéressé. Les répercussions sur l'état général sont minimes. La paracentèse du cul-de-sac donne souvent un liquide rouge sombre qui aide à signer le diagnostic. Des annexes anormales furent impliquées dans quatre cas et des ovaires normaux dans trois. Le rapport de gauche à droite s'établit à 4:3. La loi Kustner n'a pas tenu dans deux cas où le sens de la torsion fut décrit.

# SPLENIC PULP MANOMETRY IN DIFFERENTIAL DIAGNOSIS OF GASTROINTESTINAL BLEEDING

The differential diagnosis of acute upper gastrointestinal bleeding is discussed by Panke et al. (Surg. Gynec. & Obst., 109: 270, 1959) with a view to diagnosing cases bleeding from œsophageal varices. As the mortality rates in these cases is as high as 30-50% with the first bleeding episode, a portal-systemic shunt operation is often desirable. The most useful recent test has been the determination of the serum ammonium level. Its limitations, where a shunt has already been performed, are mentioned. The bromsulfalein retention test of liver function may be positive in conditions other than cirrhosis. Œsophagoscopy is often inconclusive and a barium swallow may fail to show the varices.

The technique of splenic pulp manometry suggested by the authors is simple. A number 18-gauge needle is inserted under local anæsthesia through the left 9th intercostal space at the posterior axillary line. While the patient stops breathing, the needle is inserted for 1 to 3 mm. into the splenic pulp, and a drip of blood from the needle confirms the position. The pressure is taken with a water manometer with the zero line at the table level. A short length of rubber tubing is interposed for flexibility. The needle is cleared with a few c.c. of

saline and the average of three readings recorded. The pressure readings are corrected to 12.0 cm. above the plane of the table to correspond with the level of the portal vein.

Out of 113 cases with active or recent bleeding, there were only 11 cases that fell into an overlap zone. The pressure in these cases varied from 250 to 290 mm. of water. Only four of these 11 cases were due to bleeding œsophageal varices. In these cases it is necessary to carry out splenoportography as well as splenic pulp manometry.

All cases in which splenic pulp pressure was greater than 290 mm. of water had bled or were bleeding from æsophageal varices. In all cases with a pressure less than 250 mm. of water, bleeding was from some other cause.

The splenic pulp pressures correlated well with the actual portal vein pressures as determined at operation. The splenic pulp pressure was found to remain high, even when the patient was hypovolæmic or hypotensive. If the pressure is below 300 mm. water, the bleeding will stop spontaneously or may be stopped by Sengstaken-Blakemore tube tamponade. There is thus time for further investigation in these patients.

The suggestion is made that percutaneous splenic pulp manometry alone may yield valuable diagnostic information as to the presence or absence of varices in patients bleeding acutely from the upper gastrointestinal tract.

# CASE REPORTS

# VOLKMANN'S ISCHÆMIC CONTRACTURE:

# TWO CASE REPORTS WITH IDENTICAL LATE SEQUELÆ

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A SHORT while before his death, Dr. Gallie suggested that I publish the records on two very interesting cases of his with remarkably long and careful follow-up records, one of which dates back 44 years. The relatively recent occurrence of complications in both cases has prompted this report.

Case 1.—M.K., a three and a half year old boy, was brought to Dr. Gallie in August 1914. He had non-union of the left femur of some duration and an advanced severe Volkmann's ischæmic paralysis involving the left lower leg and foot. There was no sensation below the knee and all the muscles were reported "as hard as stone".

Dr. Gallie operated on the femur and used bone screws in the treatment of the non-union. A good union ensued and the boy was eventually able to walk. At the same time he also lengthened the heel cord because of an equinovarus deformity. The next progress note was in September 1919, when the boy returned with a calcaneo-valgus deformity. Dr. Gallie operated upon him then, performing a Whitman astragalectomy.

In April 1935, he consulted Dr. Gallie because of an aching pain and mild swelling in the front of the leg. Roentgenograms at the time showed some degree of calcification in the anterior crural muscles.

In February 1951, then 40 years of age, the patient reported back with a four year history of a sore swelling increasing in size, in the front of the leg. However, the foot was very good. The swelling was fusiform, about eight inches long, and occupied the position of the tibialis anterior muscle. It was fluctuant and painless with no signs of inflammation. All power of dorsiflexion was gone. In March 1952, Dr. Gallie operated upon him and excised the entire cystic mass. The pathologist's report described the lesion as an organized hæmatoma with calcification and cyst formation (Figs. 1a and 1b).

Case 2.-W.C.J., an eight year old boy was first seen by Dr. Gallie in March 1922. In

July 1921, he suffered a fracture of the right femur and was treated with a splint by he family doctor. During the first 10 days he was unconscious owing to a skull fracture and was unable to report whether he had any pain in the leg. He had severe equinovarus deformity of the right foot and absent muscle power in the anterior crural muscle group. Treatment consisted of a succession of splints until November 1929 when Dr. Gallie performed a Hoke arthrodesis. Dr. Gallie stated at the time that he was not able to put the head of the talus back because there was no room for it after the deformity had been corrected.

The next note in October 1948 details the history of a lump on the front of the leg developing slowly over eight to nine years which more recently had become very prominent, extending down to the external malleolus. The mass measured eight inches in length and was fluctuant. Radiographs revealed a fusiform swelling with calcified walls (Figs. 2a and 2b). In December 1948, Dr. Gallie excised the complete mass. The pathologist reported the lesion as exhibiting hæmorrhagic necrosis with calcareous degeneration. The man was last seen in February 1950 when he was in good health and free of symptoms.

#### COMMENTS

These two cases represent a life-time of practice and follow-up. They also portray the natural history of Volkmann's paralysis and the final fate of involved muscle. There is little doubt that these cystic masses represent the late and final state following necrosis of muscle.

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# RÉSUMÉ

Cet article est la présentation de deux cas de syndrome ischémique de Volkmann ayant entra né des complications identiques.

Premier cas.—En août 1914, un enfant de trois ans et demi est examiné pour une absence d'union

<sup>\*</sup>Dr. Gallie died on September 25, 1959.

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Fig. 1a.

Fig. 1b.

du fémur gauche, accompagnée d'une paralysie ischémique de Volkmann dans la jambe et le pied gauches. Une intervention est pratiquée au cours de laquelle on traite la désunion fémorale par un vissage et l'on allonge le tendon d'Achille pour corriger un varus équin. En 1919, un valgus calcanéen est apparu, que l'on traite par une astragalectomie selon Whitman. En 1935, le patient

revient en consultation, se plaignant de douleurs et d'enflure en avant de la jambe: les radiographies montrent un certain degré de calcification des muscles antérieurs cruraux. En 1951 une masse fusiforme, longue de huit pouces, fluctuante et indolore était présente dans la région du muscle tibial antérieur. Cette masse fut excisée en 1952: il s'agissait d'un hématome organisé avec des



Fig. 2a.



Fig. 2b.

formations kystiques et des placards de calcification.

Deuxième cas.—En 1921, un enfant de sept ans est traité à domicile pour une fracture du fémur droit, par la pose d'une attelle; il reste inconscient pendant une dizaine de jours, du fait d'une fracture du crâne concomitante. Un an plus tard, une déformation en varus équin s'installe, accompagnée d'une paralysie des muscles cruraux antérieurs.

En 1929, on pratique une arthrodèse selon Hobe. En 1948, apparaît en avant de la jambe, une maise longue de huit pouces, fluctuante et indolore. Une excision est faite: il s'agit là encore d'une nécrose hémorragique avec foyers d'incrustation calcai e.

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# ORCHITE GRANULOMATEUSE PRESENTATION DE DEUX CAS A NOMBREUSES SPERMATIDES\*

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L'ORCHITE granulomateuse est une lésion souvent prise en clinique pour une tumeur. Son aspect microscopique est celui d'un ranulome pseudo-tuberculeux et cette lésion a déjà été confondue avec une tubercul se testiculaire et même avec une maladie ce Hodgkin du testicule. Quoique ses caractères histologiques soient maintenant bien précisés1-3 l'étiologie de l'orchite granulomateuse demeure encore inconnue. Vu lintérêt croissant que l'on porte à cette lésion, nous présentons deux observations où l'examen histologique montra de nombreuses inclusions intracellulaires, qu'il est logique de considérer comme des résidus de spermatides.

### OBSERVATIONS CLINIQUES

Un homme de 50 ans avait constaté depuis un mois et demi une augmentation progressive de son testicule droit, apparue sans douleur et sans cause évidente. Il ne présente aucun signe de prostatisme et ne se rappelle pas avoir souffert de traumatisme à cet endroit. L'examen montre un homme bien conservé pour son âge; le testicule droit cependant a un volume triple de la normale. Le traitement médical antiinfectieux ayant échoué, on pratique une orchidectomie. Le testicule, enlevé avec l'épididyme et 5 cm. de cordon, mesure 6 x 4 x 3 cm. et présente à la coupe un parenchyme brunjaunâtre, homogène et semi-ferme. La vaginale testiculaire est épaisse et soudée par endroits par des adhérences fibreuses assez denses.

Le deuxième malade, un homme de 60 ans, consulte également pour une tuméfaction testiculaire du côté droit. La lésion s'est développée progressivement depuis plusieurs mois. Il aurait ressenti quelques douleurs sourdes dans cette région, mais à l'examen la sensibilité normale est considérablement diminuée. Le malade n'est pas prostatique et à l'interrogatoire le seul traumatisme relevé dans la région est une herniotomie pratiquée 27 ans auparayant.

La cure chirurgicale consiste dans une orchiépididymectomie avec 4 cm. de cordon. Le

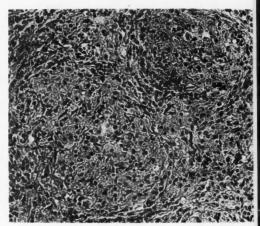


Fig. 1.—Orchite granulomateuse: aspect pseudotuberculeux de la lésion, Hémalun—érythrosine safran, x 180.

testicule pèse 136 g. et mesure 5.5 x 4.0 x 4.0 cm.; à la coupe, il a une couleur jaunâtre homogène et une consistance semi-ferme. La vaginale est épaisse et cartonnée avec une surface interne granuleuse.

# CONSTATATIONS MICROSCOPIQUES

L'aspect histologique des lésions des deux cas est assez semblable. A l'épididyme, les canaux sont revêtus par un épithélium sensiblement normal et ils ne contiennent pas de spermatozoïdes. Entre les canaux, le tissu interstitiel est plus abondant et plus riche en collagène que normalement et contient, en petites trainées, un infiltrat lympho-plasmocytaire clairsemé avec ici et là, quelques rares polynucléaires.

La vaginale testiculaire, scléreuse et d'environ quatre fois l'épaisseur normale, contient également quelques lymphocytes et plasmocytes isolés. Dans le deuxième cas la séreuse est recouverte par endroits d'un léger exsudat fibrineux avec quelques polynucléaires.

Au testicule, la lésion est diffuse, homogène, intéressant tout le parenchyme. Au faible grossissement la structure générale du testicule est encore reconnaissable. Correspondant aux tubes séminipares, il y a des formations arrondies solides, faites de cellules vaguement épithélioïdes à disposition folliculaire avec parfois

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Fig. 2.—Orchite granulomateuse: inclusions colorées par la méthode de Gomori à la méthénamine —nitrate d'argent. x 720.

dans la région centrale un petit nombre de plasmocytes. Ces structures ne contiennent plus de cellules de Sertoli, ni de cellules de la lignée germinale, reconnaissables comme telles. Les cellules épithélioïdes sont arrondies, polygonales et parfois légèrement allongées, avec des limites très floues. Leur protoplasme



Fig. 3.—Testicule normal (homme de 37 ans). Appareils acrosomiques de spermatides mis en évidence par la méthode de Gomori à la méthénamine—nitrate d'argent. x 720.

est acidophile et finement granuleux et le ir noyau, généralement rond, avec une chromatine fine et un petit nucléole (Fig. 1).

Ces structures sont séparées les unes des autres par des trainées importantes de tis u fibreux avec un infiltrat cellulaire par places assez dense, fait surtout de plasmocytes et d'un nombre modéré de lymphocytes. Ce tis u interstitiel contient en outre par endroits des trainées de cellules acidophiles épithélioï des du même type que celles des structures foi iculaires. Quelques-uns de ces éléments sont binucléés, mais aucum ne présente les caractères d'une cellule géante plurinucléée.

Sur les coupes où la réticuline est colorée par la méthode de Laidlaw, ce tissu interstitiel est très riche en fibres argentophiles. Des fibres sont orientées autour et délimitent assez nettement les structures folliculaires, dont la moitié périphérique contient aussi quelques fibres isolées.

L'élément particulier de ces lésions granulomateuses testiculaires est la présence d'inclusions dans le protoplasme des cellules de type épithélioïde (Fig. 2). Ces inclusions sont arrondies et généralement uniques, quoique ici et là, quelques cellules en contiennent deux ou trois. Parfois quelques-unes semblent être libres dans les espaces intercellulaires. Dans le deuxième cas ces formations sont extrêmement nombreuses et on peut en compter une vingtaine dans chaque champ microscopique à un grossissement moyen. Elles mesurent de 4 à 7 µ de diamètre et sont très difficiles à identifier sur les coupes habituelles à l'hémalun-érythrosine-safran, surtout après fixation au Bouin. Avec un trichrome de Masson au "lightgreen", elles prennent une teinte légèrement verte, mais c'est surtout avec la technique à l'acide périodique-Schiff (APS) de McManus et avec la technique à la méthénamine-nitrate d'argent (MNA) de Gomori<sup>4</sup> qu'elles deviennent très évidentes. Dans le premier cas, ces inclusions sont colorées intensément en rougepourpre, dans le second, elles apparaissent nettement en brun ou en noir et leur morphologie est alors plus facile à reconnaître. Quelques-unes ont une forme ovoïde ou en poire, mais la grande majorité sont bien rondes. Certaines sont homogènes et uniformément co orées, tandis que d'autres sont faites d'une coq le dense plus ou moins épaisse et d'un centre incolore. Entre ces deux aspects, il y a bien ces formes intermédiaires et les plus nombreu es ont un centre légèrement coloré et en périphé ie une fine membrane opaque. Ces structures ne sont pas colorées par la méthode simple de Ziehl-Neelsen et ont une couleur rose pâle :ur les coupes traitées par la méthode de Pu t,5

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une modification du Ziehl-Neelsen, employée par Berg<sup>6</sup> pour l'identification des spermatozoïdes. Au Feulgen et au Gram également ces formations ne sont pas colorées. Pour la mise en évidence des graisses, le soudan noir et l'écarlate R. ont été employés et pour toutes les formes d'inclusions seulement une fine cuticule périphérique a été colorée.

Le protoplasme de plusieurs cellules épithéloïdes, surtout au centre des structures folliculaires, en plus de contenir des inclusions, est bourré de grosses granulations, peu visibles avec les colorations de routine, mais fortement t intes par l'APS et la MNA.

# COMMENTAIRES

Les deux cas rapportés peuvent être classés avec les lésions décrites sous le nom d' "orchite granulomateuse". L'origine des cellules macrophagiques épithélioïdes a été impossible à préciser sur nos préparations. Il semble bien qu'elles prennent naissance à l'intérieur de tubes séminipares préexistants, mais sans qu'on puisse dire qu'elles soient une transformation d'éléments sertoliens ou germinaux.

La nature des inclusions intracellulaires est plus facile à déterminer. Bien qu'elles soient positives à l'APS et à la MNA, elles n'ont pas la morphologie d'éléments levuriformes. Par contre elles rappellent de très près les noyaux de spermatides. Si l'on examine des testicules normaux avec ces deux techniques de coloration, le rapprochement se fait facilement. Clermont et Leblond ont montré comment le granule acrosomique et le capuchon céphalique des spermatides en maturation se colorent électivement par l'APS.7 Nous avons remarqué que ces éléments normaux sont mis en évidence d'une façon encore plus fine par la MNA, après fixation au formol (Fig. 3). Les inclusions décrites dans nos deux cas d'orchite granulomateuse ont les mêmes caractères tinctoriaux et les mêmes dimensions que les appareils acrosomiques des spermatides. Leur réaction positive aux colorants des graisses permet également la même conclusion.8 Aucun spermatozoïde n'a été vu dans nos préparations colorées au Putt-Berg. Si ces inclusions n'ont pas exactement la morphologie d'appareils acrosomiques normaux, elles rappellent cependant celui de spermatides modifiées qui, suivant la classification de Clermont et Leblond, seraient à la phase du capuchon ou dans les premières étapes de la phase de l'acrosome.<sup>7</sup>

Nous ne connaissons pas de descriptions de lésions humaines contenant ainsi des résidus de spermatides arrêtées dans leur maturation. Cependant, on voit fréquemment ces images chez le rat, après traitement à l'éthionine ou après une carence expérimentale en acides aminés essentiels. Au cours de l'atrophie simple du testicule chez le même animal des spermatides ainsi modifées sont fréquentes. 10

La nature précise des granulations positives à l'APS et à la MNA, en plus des spermatides modifiées, dans les cellules épithélioïdes, nous échappe. Ces granulations sont encore positives à l'APS après digestion à la maltase et ne correspondent pas à du glycogène. Friedman et Garske<sup>3</sup> ont décrit une substance granuleuse identique dans des cas d'orchite granulomateuse et la signalent comme étant probablement des "nucléoprotéines spermatiques".

Rien dans nos deux observations peut éclairer le problème de l'étiologie de l'orchite granulomateuse. Cette lésion est souvent considérée comme traumatique. Chez nos deux malades, il n'y avait cependant aucun antécédent traumatique. Contre l'hypothèse d'une infection mycobactérienne, aucun bacille acido-alcoolo-résistant n'a été vu sur les coupes histologiques. Il y aurait encore à considérer les possibilités d'une intoxication, d'un processus immuno-pathologique à isoanticorps, d'un déséquilibre endocrinien avec excès d'hormones hypophysaires gonadotrophiques au cours d'une insuffisance hépatique, facteurs étiologiques qui expliquent chez l'animal le développement de lésions où la maturation spermatocytaire est inhibée. Chez l'animal cependant les lésions intéressent toujours les deux testicules à la fois et, en autant qu'on peut le juger, les lésions chez nos deux malades étaient unilatérales.

#### RÉSUMÉ

Deux cas d'"orchite granulomateuse" unilatérale sont rapportés. Le diagnostic a été fait à l'examen histologique après orchidectomie chez deux malades de 50 et 60 ans respectivement, qui avaient consulté

pour une tuméfaction testiculaire apparue sans cause apparente.

Les lésions granulomateuses contenaient de nombreuses inclusions arrondies, très bien mises en évidence par les techniques à l'acide périodique-Schiff et à la méthénamine-nitrate d'argent. Les caractères morphologiques de ces inclusions permettent de croire qu'elles correspondent à des spermatides modifiées, à la phase du capuchon ou dans les premières étapes de la phase de l'acrosome.

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# SUMMARY

Two cases of "granulomatous orchitis" appearing in two patients of 50 and 60 years of age without any apparent cause are reported. The diagnosis was made on microscopic examination after orchidec-

granulomatous lesions contained many round bodies of 4 to 7 \mu in diameter, which were stained positively by the periodic acid-Schiff technique and Gomori's silver nitrate-methenamine method. On account of their morphology and staining reactions, these bodies are believed to be modified spermatids in the cap phase or the first stages of acrosomic phase. They resemble closely spermatids in an arrested stage of maturation as seen for instance in the rat treated by ethionine or deprived experimentally of some essential aminoacids.

# CORRIGENDUM

#### THROMBOSIS AND ENDOTHELIAL REPAIR

In the article "Observations on Thrombosis and Endothelial Repair Following Application of External Pressure to a Vein" (Canadian Journal of Surgery, 3: 5-16, October 1959) the legends for Figures 11 and 12 were transposed. The legend for Fig. 11 should read "Fusiform cells and platelets on the surface of a lesion examined 60 hours after the application of 100 grams for one hour. Silver nitrate and Harris's hæmatoxylin (x 800).

The legend for Fig. 12 should read "Endothelial cell mitosis at periphery of lesion. Argyrophilic lines participating in the development of the daughter cells. Silver nitrate and Harris's hæmatoxylin (x 1700)."

# THIRD INTERNATIONAL CONGRESS OF PHYSICAL MEDICINE

The Third International Congress of Physical Medicine will be held August 21-26, 1960, inclusive, at the Mayflower, Washington, D.C.

The preliminary prospectus covering the international conference carries in detail information on registration, application to present a paper, a scientific exhibit, a scientific film, etc. A copy of this preliminary program may be had on request by writing to Dorothea C. Augustine, Executive Secretary, Third International Congress of Physical Medicine, 30 North Michigan Avenue, Chicago 2, Illinois, U.S.A.

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# UNILATERAL URETERAL OBSTRUCTION DUE TO ENDOMETRIOSIS

ERNEST G. MEYER, M.D., M.S., F.R.C.S.[C], \* Toronto

UNILATERAL ureteral obstruction as the sole manifestation of endometriosis is a very rare condition. The literature to date contains reports of nine cases, the case reported below being the tenth. A full four year fellow-up was rigorously applied before p esenting this case, so that the final results of therapy would be manifest. The term endometriosis as we know it refers to the p esence of endometrial tissue in locations other than the uterus, and there are three theories about its pathogenesis, namely Sampson's theory of uterine spillage; the theory of embryonic rests; and the theory of metaplastic origin. We are concerned in this paper only with its relation to unilateral ureteral obstruction.

# DIAGNOSIS

Ureteral obstruction may be caused: (1) by conditions arising within the ureter, such as stone, tumour, stricture or inflammatory disease; (2) by conditions arising from the adjacent organs or areas involving the ureter, such as tumours of the ovary, uterus or broad ligament, or retroperitoneal tumours.

## Symptoms

The symptoms may consist of those of ureteral obstruction alone, endometriosis alone, or both. The fact that the symptoms are cyclical in character in relation to the menstrual cycle may point to the disease. Pain may be the only feature. In our case, pain due to ureteral obstruction was the sole manifestation. The disease is commonest in the pre-menopausal period, and the last two cases reported occurred shortly before the menopause was expected.

# PHYSICAL FINDINGS

No palpable masses or tenderness may be present, though slight tenderness over the kidney has been observed. These women usually present scars of previous

herapy would be manifest. The term ometriosis as we know it refers to the

ligament.

by the degree of obstruction. Microscopic hæmaturia and a slight trace of albumin may be present. Pyuria, a raised leukocyte count and a raised erythrocyte sedimentation rate are noted only in cases of superimposed infection.

The laboratory findings will be governed

pelvic operations. A questionable thicken-

ing may be felt in the areas of the broad

# UROLOGICAL INVESTIGATION

LABORATORY FINDINGS

The plain film of kidneys, ureters and bladder will reveal little unless the kidney is grossly enlarged. The intravenous pyelogram will demonstrate ureteral obstruction in the lower third with or without associated hydroureter and hydronephrosis. The radiologist will report obstruction due to non-opaque calculus, ureteral stricture or tumour. Endoscopy will reveal the presence or absence of vesical implants; in their absence, ureteral catheterization may demonstrate the site and dimensions of obstruction. Papanicolaou stains of the ureteral urine could be of value in differentiating mural invasion by endometriomata from primary or secondary ureteral malignant tumours.

#### TREATMENT

Treatment includes the correction of the deformity and the removal of the cause. Endometriosis may be treated by operation, x-ray or hormonal castration. Unfortunately it may not be recognized until the ureter is explored and frozen sections are examined. Bilateral oophorectomy is then the treatment of choice. Co-existing disease in the rest of the pelvic organs can be treated concurrently. The presence of a minimal amount of endometriosis, comprising only a small puckering of the peritoneal surface. has been found to cause ureteral obstruction. Retroperitoneally the ureter has been found completely surrounded by a dense scar-like tissue extending for 2 to 3 cm.

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<sup>&</sup>lt;sup>6</sup>812 Medical Arts Building, Toronto 5, Ontario.



Fig. 1.—Preoperative pyelogram showing obstruction to dye and catheter on left side.



Fig. 2.—Preoperative pyelogram showing level of obstruction to ureteral catheter.

The case to be reported was treated by local excision of the obstruction and a ureteroplasty over a splinting catheter. The site of the obstruction was not low in the pelvis but at the pelvic brim.

#### CASE REPORT

Mrs. A.O., a 48 year old white multiparous woman, was admitted to hospital on February 4, 1955, co.nplaining of left lower quadrant pain radiating to the left costo-vertebral angle and lasting for one hour. This was accompanied by chills and required meperidine (Demerol) for relief of pain. Careful questioning revealed that her symptoms to a lesser degree had been present for 18 months. She had been in hospital four months previously for a cholecystectomy for cholelithiasis. Previous pelvic surgery included an appendectomy and removal of a cyst from the right ovary years ago. Her menstrual cycle was normal and she had no hæmaturia.

On examination she was in no apparent distress. There was slight tenderness over the left kidney and ureter. Microscopically, the urine showed an occasional pus cell and red cell. The specific gravity was 1.020. The blood pressure was 136/66 mm. Hg and the pulse 72. There was evidence of a recent gallbladder excision plus an old right lower rectus scar. Pelvic examination revealed a freely movable uterus and a suggestion of a small fibroid. The pelvic lining was not nodular, but there was a sensation of thickening in the region of the left broad ligament. The hæmoglobin value was 13.8 g. %, leukocyte count 8300, red cell count 4,900,000 and the nonprotein nitrogen 22. The urine cultures showed no growth. The adm ssion film of kidneys, ureters and bladder showed a questionable ar a of increased density in the line of the left ureter opposite the sacroiline joint. Intravenous pyelography (Figs. 1, 2 and 3) revealed a left hydronephrosis and hydroureter. The site of the obstruction and its cause were

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nct visualized. Endoscopic examination showed the bladder to be free of lesions. The left ureter was blocked at 10 cm. to 4, 5 and 6 Fr. catheters. It was felt that cystoscopy and ureteral catheterization under an esthesia would give us more information on the state of the ureter at also allow us to make a thorough polyic examination. This only confirmed total obstruction at 10 cm. After a pelvic examination, a staff gynaecologist was of the opinion that the lesion was possibly a uterine filt roid, but that there was no malignative.

On February 14, 1955, the area was explored through a Gibson incision and the ureter was approached ex raperitoneally. The proximal ureter at the brim of the pelvis was grossly dilated. No stone was palpated. There was a fibrous, gritty mass involving the ureter for about 3 cm. This appeared mainly on the medial side. The ureter was carefully freed for about 3 inches (7.5 cm.) where it crossed the pelvic vessels. As the ureter was freed from this gritty, fibrous mass, it rolled up and out of its encasement. On opening the ureter it appeared to be free of tumour invasion but presented a sharp stricture at the level noted. Ouick sections by Dr. L. S. Mautner, our pathologist, revealed smooth muscle tissue, throughout which were numerous endometrial implants composed of glandular structures surrounded by typical endometrial stroma (Fig. 4); in some areas a few collections of mononuclear cells were seen. There was no evidence of malignancy. A diagnosis of endometriosis of periureteral tissue was made. The ureter was then incised across the stricture for a distance of cm. A long-limbed No. 10 Fr. I-tube was inserted proximal to the stricture and the edges of the ureter were approximated with firm 0 atraumatic chromic interrupted catgut in Davis fashion. The peritoneum was not opened. The wound was closed with interrupted chromic catgut and the skin with silk.

Postoperative progress was uneventful. On the 14th day a subtotal

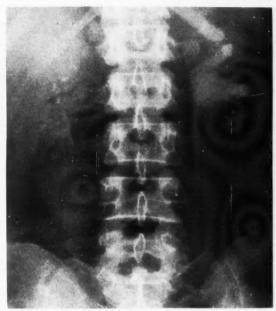


Fig. 3.—Preoperative intravenous pyelogram showing loss of function and hydronephrosis—30 minute delayed film.

abdominal hysterectomy and a bilateral salpingo-oophorectomy was carried out by Dr. W. T. G. Knowlton, staff gynæcologist. The only manifestation of endometriosis was a small puckered area at the level of the base of the T-tube. The entire peritoneal surface was otherwise smooth and intact.

The gross specimen included a uterus 6 x 8 x 3 cm. with a few interstitial fibroids, the largest being 2 cm. The endometrium was not remarkable. One ovary con-

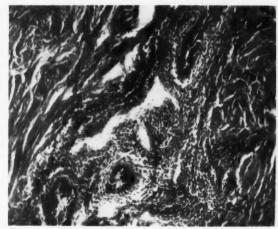


Fig. 4.-Endometriosis of periureteral tissue (H & E x 240).



Fig. 5.—Intravenous pyelogram taken four years postoperatively.

tained a recent corpus luteum. One follicular cyst was present. The tubes measured 4 x 1.5 cm. The peritoneum was smooth, the lumen was patent. Microscopically sections from the uterus showed atrophic endometrium. The myometrium contained a tumour composed of interlacing smooth muscle and connective tissue fibres. Sections from the tube were not abnormal. Sections from the ovary showed the presence of some follicular cysts and germinal inclusion cysts. One ovary had some granulation tissue on the surface which was surrounded by an extensive zone of fresh hæmorrhage. In one area a glandular structure was seen within this tissue, and in an adjacent area a gland was seen surrounded by stroma which might have been of endometrial origin. This could not be determined with certainty. In all sections there was no evidence of malignancy.

#### DIAGNOSIS

1. Fibromyomata of uterus.

- Follicular cysts and germ nal inclusion cysts of ovary.
- 3. Endometriosis of one ovary

Twenty-four hours later, on he patient's 15th postoperative day, he T-tube came out of the ureter and was therefore removed. The incis on remained dry and progress was ineventful. The patient was discharged home on March 11, 1955.

#### COMMENTS

We would have preferred to have allowed the drain to remain in for 21 days, but as it dislocated on the 15th day we had no choice but to remove it. This patient has been seen only once yearly and the condition followed up by intravenous pyelography. Fig. 5 was taken at the conclusion of four years of follow-up. Were we to encounter another such case, it would be treated by insertion of a splinting polyethylene catheter for 21 days.

# SUMMARY

A case of unilateral ureteral obstruction as a sole manifestation of endometriosis has been presented. There were no other symptoms. Therapy consisted of freeing the ureter, incising the stricture, and splinting. A four year follow-up has been terminated. This is believed to be the 10th reported case of unilateral ureteral obstruction as a sole manifestation of endometriosis.

I am indebted to Dr. L. S. Mau'ner for pathological sections, and to Dr. W. T. G. Knowlton, for his gyna-cological help.

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## RÉSUMÉ

On trouve dans la littérature plusieurs rapports co cernant une obstruction unilatérale de l'uretère, come manifestation unique de l'endométriose; cer est toujours considéré comme rare. Il est raporté ici un cas de ce genre (qui est le dixième à tre publié); celui-ci remonte à quatre ans et a té, durant cette période, soigneusement étudié de façon à apporter des conclusions valables.

résentation de cas.—Une multipare âgée de 48 an est admise à l'hôpital en 1955, se plaignant de do leurs dans le côté inférieur gauche du ventre; ces douleurs étaient suffisament fortes pour nécessiter des injections de Démérol. D'après l'interrogatoire ces symptômes existaient depuis 18 mois;

la patiente avait, par ailleurs, subi une cholécystec-tomie pour lithiase biliaire quatre mois plus tôt, et aussi, quelques années auparavant, une appen-dicectomie et l'ablation d'un kyste de l'ovaire droit. Les examens d'urines montrèrent la présence de quelques globules rouges et d'un peu de pus. À l'examen gynécologique, l'utérus était mobile, mais le ligament large gauche semblait quelque peu épaissi. Le pyélogramme intraveineux mit en évidence une hydronéphrose et une dilatation urétérale gauches; cependant la cystoscopie montra une vessie normale. On procéda alors à un cathétérisme urétéral sous anesthésie, qui permit de découvrir une obstruction de l'uretère gauche à 10 cm. au-dessus de son abouchement vésical. On pratiqua alors une laparotomie par incision de Gibson: l'uretère gauche était fortement dilaté et l'on palpait à son intérieur une petite masse qui n'était pas un calcul; une biopsie permit de diagnostiquer une hypertrophie du tissu musculaire lisse avec des plaques d'endométriose; on incisa Quinze jours plus tard, une hystérectomie abdo-minale subtotale et salpingo-ovariectomie bilatérale furent effectuées; les suites opératoires n'eurent aucune histoire. L'anatomie pathologique ne révéla aucune malignité.

# SIDE ACTIONS OF MUSCLE RELAXANTS°

"When one compares the known pharmacology of these drugs with clinical reports on their use, doubt arises as to how many of the actions apart from neuromuscular block have practical importance. But an important difference between laboratory work and clinical practice deserves emphasis. Most pharmacological analyses rest on experiments performed on a few tens of animals at most; but the drugs may be used clinically in thousands of patients. How is it possible, by necessarily limited animal work, to predict or assess for the clinician the possible abnormal responses which may occur, during his use of a drug both in healthy and diseased men? Ultimately of course this assessment must be a clinical one. But in the preliminary stages, at least, it is useful to pay attention to two points. First, any action displayed by a drug, even if only in a particular species, may turn up in human practice. Thus the toxicity of oxygen at pressures below one atmosphere, especially marked in rats, has proved to have a human correlate; the excitant

action of morphine in the cat likewise fore-shadows a similar action in a few humans, contrasted with its normal 'sedative' action. Secondly, it is sometimes possible, when a side-action by a drug is the therapeutic action of some other recognized drug, to assess the likelihood of the side-action by considering the known variations in response to the latter drug: thus the ganglion-blocking action of d-tubocurarine can be interpreted in the light of our experience with hexamethonium . . .

. . . If this argument is admitted, then it would be reasonable for the clinician to seek from the pharmacologist both an accurate identification of all the significant side-actions of a new drug and also, where possible, an estimate of the intensity of those side-actions in terms of familiar drugs. A subsequent quantitative assessment of the side-actions in clinical practice then becomes of interest to the pharmacologist for the light it throws on human responses as compared with those of animals. Although the close study of side-actions is a less attractive and usually a less important side of therapeutics than, say, the attempt to discover new drugs or to explain the actions of familiar but mysterious ones, there can be little doubt that further attention to them would bring about a valuable refinement in anæsthetic technique.'

PATON, W. D. M.: The effects of muscle relaxants other than muscular relaxation, Anesthesiology, 20: 461, 1959.

# REVIEW ARTICLE

# THE INTRAPERITONEAL AND LOCAL USE OF NITROGEN MUSTARD (MECHLORETHAMINE) AT THE TIME OF OPERATION FOR GASTROINTESTINAL CANCER\*

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A CLINICAL investigation is being undertaken to determine whether nitrogen mustard used at the time of operation decreases the incidence of cancer recurrences. Nitrogen mustard is introduced into the lumen of the gut in an attempt to kill free cancer cells and thereby to decrease the incidence of cancer recurrences at the site of intestinal anastomosis. Nitrogen mustard is placed in the peritoneal cavity to deal with cancer cells which may be present in the peritoneal fluid. In addition, nitrogen mustard placed in the peritoneal cavity is absorbed into the portal circulation and it is hoped will control cancer cells which have entered the portal blood stream and have been taken up by the liver. Operative wounds and the perineal wounds after abdomino-perineal resection of the rectum are irrigated with nitrogen mustard in an effort to kill cancer cells which may be contaminating these sites.

Nitrogen mustard (mechlorethamine hydrochloride, N.F.) was first used clinically in 1942 for the treatment of a patient suffering from a malignant lymphoma. Subsequently it has been found of value for the palliative treatment of some of the neoplastic diseases of the lymphoid and hæmopoietic systems e.g. Hodgkin's disease. Nitrogen mustard is sometimes useful in the treatment of both primary and secondary lung carcinomata, but when injected by a systemic vein it is only occasionally of value for carcinomata elsewhere in the body. In patients suffering from bronchogenic carcinoma, nitrogen mustard sometimes causes a decrease in cough, pain, dyspnœa and hæmoptysis, and occasionally pleural effusions and tumours become smaller. These changes most frequenly occur when the tumours are anaplastic. Pleural effusions due to metastatic dise se of the ovary and breast sometimes decrease after instillation of nitrogen mustard into the pleural cavity. Nitrogen mustard probably produces an effect on some pulmonary tumours because of its higher concentration in the lungs, due to their rich blood supply. than in other tissues. This explanation is supported by the fact that carcinomata and sarcomata in other parts of the body sometimes respond when nitrogen mustard is injected directly into the artery supplying the tumour region. Bierman and his coworkers have found objective improvement in seven out of 34 patients suffering from advanced pelvic malignancy when nitrogen mustard was injected into the aorta below the level at which the aorta and inferior vena cava were clamped; the femoral vessels were obstructed by tourniquets.1 The dose of nitrogen mustard administered varied from 0.2 to 1.6 mg./kg. of body weight. An even higher concentration of nitrogen mustard has been obtained in the tumour by Creech and associates2 by perfusing the tumour through an extracorporeal circulation; for pelvic malignant tumours the aorta, the inferior vena cava and femoral vessels were occluded.

Nitrogen mustard inhibits cell division in its premitotic phase and this forms the basis for its therapeutic use. With the dose used clinically (0.4 mg./kg. body weiglet) only cells of the bone marrow, lymphatic tissue and some rapidly proliferating mal gnant cells are affected. However, with to de doses cells of the intestinal tract, nervous system, gonads and comea are also novolved. The toxic effects and biological changes induced by nitrogen mustard are in some aspects similar to those following irradiation, and in addition the therapeutic results are in many ways similar. For these

<sup>\*</sup>From the Department of Surgery, University of Western Ontario, and the Ontario Cancer Foundation, London Clinic, Victoria Hospital, London, Ontario. Supported by a grant from The Ontario Cancer Foundation.

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TABLE I.—PRELIMINARY RESULTS OF NITROGEN MUSTARD THERAPY AT THE TIME OF OPERATION FOR CANCER\*

		Treated	Controls		
	Breast†	Rectum‡	Breast	Rectum	
Number of cases	37	15	37	15	
Number of recurrences	5	3 (23.5 mos.§)	12	5 (19.0 mos.)	
Number of deaths	1	3 (24.5 mos.)	7	3 (18.0 mos.)	
N) cancer at autopsy		0		1	

\*After Cole et al., Ann. Surg. (In Press).

†Patients suffering from carcinoma of the breast were given nitrogen mustard into a systemic vein; 0.? mg. per kg. body weight at the time of operation and 0.1 mg. per kg. on the two days following operation. †Patients suffering from carcinoma of the rectum were given nitrogen mustard (0.1 mg. per kg. body wight) in 400 c.c. physiological saline intraperitoneally and 0.1 mg. per kg. intraportally at the time of operation and 0.1 mg. per kg. body weight of the drug into a systemic vein on the two days after operation. §In brackets () is the average number of months that the patients survived after operation.

TABLE II.—Incidence of "Takes" of the Walker 256 Tumour when Nitrogen Mustard was Given One Hour after the Cells\*

Intraportal cells			Intraperitoneal cells					
	Group 1	Group 2	Group 3	Group C	Group 4	Group 5	Group 6	Group C
Route of HN <sub>2</sub> administration Number of rats	Intra- portal	Intra- peritoneal	Systemic venous	Control	Intra- portal	Intra- peritoneal	Systemic venous	Control
with "takes" Number of rats	24	18	25	42	25	13	27	33
without "takes" Total animals Percentage of "takes' Probability†	19 43 53.5 <0.001	25 43 41.2 <0.001	20 45 55.5 <0.001	$\begin{array}{c} 2\\44\\95.5\\-\end{array}$	2 27 92.6 NS	17 30 43.3 <0.001	3 30 90.0 NS	0 33 100

\*McCredie, J. A. and de Peyster, F. A.: Surgery, 45: 709, 1959.

†Probability of this group and control groups were from the same population.

TABLE 111.—Incidence of "Takes" of the Walker 256 Tumour when Nitrogen Mustard was Given One Hour after the Inoculation of Cells into Subcutakeous Pockets\*

	Group 7	Group 8	Group 9	Group C
Route of HN <sub>2</sub> administration	Intraportal	Intraperitoneal	Systemic venous	Control
Number of rats with "takes"		28	31	31
Number of rats without "takes"	0	0	0	0
Total animals	28	28	31	31
Percentage of "takes"	100	100	100	100
Probability†	NS.	NS	NS	NS

\*McCredie, J. A. and de Peyster, F. A.: Surgery, 45: 709, 1959.

†Probability of this group and control groups were from the same population.

reasons nitrogen mustard is known as a radiomimetic drug. Mrazek *et al.*<sup>3</sup> have found that when nitrogen mustard (0.4 mg./kg. body weight) is given at the time of operation for cancer, there is an initial leukocytosis reaching a peak of about 13,000 cells per c.mm. on the second postoperative day. The white cell count then decreases and reaches its lowest level (about 3500 cells per c.mm.) by about the 14th day. The white cell count has usually returned to normal by the end of the third week

after operation. Economou et al. using the same dose, found that the white cell count fell to 3000 or less in only five out of 24 patients receiving nitrogen mustard at the time of operation. Cole states that no patient should receive nitrogen mustard at operation unless the white cell count is greater than 5000 cells per c.mm. and the platelet count 150,000 cells per c.mm. To prevent infection resulting from leukopenia, he recommends the administration of antibiotics to all patients although, as he points

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TABLE IV.—Irrigation of Wounds Inoculated with Cancer Cells One Hour Previously\*

		Percentage of takes	
Control (no irrigation)	86	89	
Saline, isotonic	32	100	
Oxytetracycline, 25 mg.%	30	100	
Distilled water	10	100	
Heparin, 10 mg.%	10	100	
Saline, 3%	31	90	
Phenol. 0.1%	36	86	
Phenol, 0.1%	30	83	
Chloroazodin (azochloramide) 0.05 mg.% (wound slough if			
higher concentration)	25	80	
Benzalkonium (Zephiran)			
chloride 1:1000	35	71	
Mercury bichloride, 1:1000	30	66	
Ethyl alcohol, 95%	7	57	
Strong iodine (Lugol's) solution			
U.S.P. (1/2 strength)	30	23	
Mechloramine			
(nitrogen mustard), 1 mg.%.	30	3	
Monoxychlorosene			
(Clorpactin), 2%	38	5	
*Collier, R. G. et al.: A.M.A.	Arch. Su	rg., 78: 528	
1959.			

out, there is no proof that antibiotics help. Transfusion of whole blood has probably no effect on the white cell count. Cole and associates found that the patients who received nitrogen mustard had no greater incidence of wound infection or dehiscence; however, when infection occurred, it tended to be more severe. Mrazek et al. found that more blood was required in the postoperative period. They found that treated patients required an average of 1400 c.c. of blood while those who did not receive nitrogen mustard received 860 c.c. of blood. The extra blood was given because of a falling hæmatocrit value which was believed to be due mainly to bone marrow depression rather than to loss of blood. The recommended dose of nitrogen mustard for a patient suffering from Hodgkin's disease is 0.4 mg./kg. body weight. The margin of safety however is considerably decreased when the drug is given at operation, so that great care must be taken when it is given at this time. Cole suggests that half the routine dose be given to patients over the age of 70 years and, to avoid excessive dosage in obese patients, that not more than 30 mg. of nitrogen mustard be given to any patient. He found that nitrogen mustard was the cause of serious complication in only one out of 140 patients. This patient, suffering from carcinoma of

the breast, received more than the maximum dose of 30 mg. of nitrogen mustard.

In 1956, Cole<sup>5</sup> suggested that althou th nitrogen mustard was of no value in the treatment of established tumours it might control cells disseminated at operation or recently implanted cancer cells. His gro p injected 110,000 Walker 256 tumour ce ls into the portal venous system of rats a d tested the effect of injecting nitrog n mustard (0.5 mg./kg. of body weight) intraportally, intraperitoneally or by a systemic vein on hepatic "takes" of the Walker tumour. The drug was given one minute after the cells. When the nitrogen mustard was injected intraportally, "takes" occurred in only 19% of the treated animals and in 97% of the control animals. When the drug was injected intraperitoneally or by a systemic vein it was not so effective. It was also found that nitrogen mustard injected more than one hour before or six hours after the cells did not have much protective effect. When it had been established experimentally that nitrogen mustard was effective against recently injected cancer cells, it was given to patients at operation. At first, in patients with gastrointestinal cancer, 0.1 mg. nitrogen mustard per kg. body weight (maximum dose of 7.5 mg.) was injected intraperitoneally operation and 0.1 mg./kg. was injected by a systemic vein on each of the three days following operation. Later in the clinical investigation, half the total dose was given at operation; 0.1 mg./kg. intraperitoneally in 500 c.c. saline and 0.1 mg./kg. into an omental vein in 50 c.c. of saline. The remainder was given systemically on the two days following operation. Preliminary results (Table I) from the clinical trial started by Cole and associates in 1956 suggest that in patients suffering from gastrointestinal cancer the administration of nitrogen mustard at operation decreases the incidence of cancer recurrences. A longer observation period is still necessary, because the drug may only postpone the time of appearance of the tumours and may not have such a striking effect on 5 or 10 year survival rates.

An experimental investigation was undertaken in Cole's laboratory by McCred'e and de Peyster<sup>6</sup> to find the most effective

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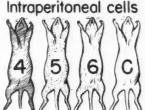
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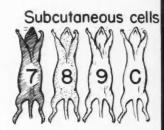
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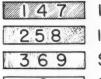


Intraportal cells





Route of nitrogen mustard administration



Intraportal Intraperitoneal Systemic vein Controls

Fig. 1.—Plan of experiment showing the groups of rats studied. (Reproduced from McCredie, J. A. and de Peyster, F. A.: Surgery, 45: 709, 1959.)

route for the administration of nitrogen mustard and to discover its effect on cancer cells injected into different tissues. Cancer cells may be disseminated at operation into the portal venous system, into the peritoneal cavity or into the operative wound; cancer cells were therefore inoculated at these sites. The drug was injected into the portal venous system, intraperitoneally and by the systemic venous route. Ten thousand Walker 256 tumour cells were injected into 12 groups of rats (Fig. 1) and nitrogen mustard (0.5 mg./kg. body weight) was injected one hour after the tumour cells. This interval was used because there is at least this interval during clinical surgery between the removal of the primary malignant tumour with possible dissemination of malignant cells and the administration of nitrogen mustard. Animals dving within 48 hours of operation were excluded from the results; those dying before or killed at 30 days were autopsied to determine the presence or absence of tumour. The results (Table II) showed that nitrogen mustard administered intraportally, intraperitoneally or by a systemic vein was equally effective against Walker 256 tumour cells introduced into the portal venous system. However, intraperitoneal injection was significantly superior to intraportal or systemic venous injection when the cancer cells were introduced into the peritoneal cavity. It was

found (Table III) that the drug had no effect on Walker tumour cells implanted in subcutaneous pockets when it was given intraportally, intraperitoneally or by the femoral vein. This work suggests that, in patients suffering from gastrointestinal cancer, nitrogen mustard may be more effective when it is all given into the peritoneal cavity rather than by a combination of the intraportal, intraperitoneal and systemic venous routes.

Contamination of wounds by cancer cells and their presence in the lumen of the gut may cause cancer recurrences. The cancer cells in the lumen of the gut may at times grow at sites of mucosal injury, but will not invade the intact mucous membrane. Metastatic growths may be found on internal hæmorrhoids, in anal fistulous tracts and at the sites of intestinal anastomoses. D'Allaines, Morgan and Lloyd-Davies7 drew attention to the importance of cancer cell implantation at sites of intestinal anastomoses. Goligher, Dukes and Busseys found that of 162 cases of anterior resection of the rectum, 10% developed recurrences at the suture line; 38% of the recurrences were at the line of intestinal anastomosis. They found that by irrigating the lumen of the gut with 1:500 perchloride of mercury the number of recurrences at the suture line was decreased. Collier et al.9 have shown that nitrogen mustard is a

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potent anti-cancer drug when directly applied to cells of the Walker 256 tumour. They implanted 10,000 Walker tumour cells into subcutaneous pockets in the abdomen of rats, and one hour later they irrigated the wounds with 100 c.c. of various solutions (Table IV) and subsequently observed the animals for tumour "takes". They found that irrigation of the wounds with 100 c.c. of nitrogen mustard at a concentration of 1 mg. per 100 c.c. resulted in "takes" in only 3% of the animals, whereas 87% of the untreated control animals developed "takes". This concentration did not interfere with wound healing. Hardesty10 found that nitrogen mustard applied locally to wounds in rats did not impair wound healing unless the concentration was greater than 2.5 mg. per 100 c.c. Graber et al.11 using rabbits, Hardesty using rats, and Morales and McDonald<sup>12</sup> using dogs found that the systemic injection of nitrogen mustard did not influence wound healing unless the drug was given in doses which frequently proved fatal. Kredel13 has irrigated operative wounds in patients with nitrogen mustard (500 c.c. containing 10 mg. of nitrogen mustard) and found that it did not interfere with wound healing. He found that skin grafts would take on surfaces irrigated with this solution. Nitrogen mustard has been given in large doses into the peritoneal cavity of patients at the time of operation for intra-abdominal cancer. Curreri has given 22 mg. and 30 mg. to two patients and Mengert 30 mg. to four with no effect on wound healing and without the development of any complications.14

The experimental and clinical work performed with nitrogen mustard suggests that it can be used with safety in the peritoneal cavity, to wash out the lumen of the gut and operative wounds. Its use at these sites may possibly decrease the incidence of cancer recurrences and, in view of its absorption from the peritoneal cavity, it may inhibit the development of hepatic metastases.

#### METHODS

The effects of irrigating sites of possible cancer cell contamination with nitrogen mustard and of giving nitrogen must rd intraperitoneally in one dose are be ag studied in two groups of patients suffer ag from gastrointestinal cancer:

#### 1. "Attempted Curative" Series

The patients selected are those suffer ig from intra-abdominal carcinoma of the gastrointestinal tract in whom a curat ve operation is planned. No patient is given nitrogen mustard unless the white cell count exceeds 5000 cells per c.mm. and an acequate platelet count (exceeding about 150,000 cells per c.mm.) is present. The patient is placed in the "attempted curative" series if it has been possible to perform a radical cancer operation and there is no known tumour tissue remaining after the operation. If the serosa over the tumour has been invaded and some free fluid is present in the peritoneal cavity, the case is still included in the "attempted curative" series. A patient is not included in this series if it has not been possible to perform a radical cancer operation e.g. when the area of lymphatic drainage of a tumour has not been removed owing to the poor general state of the patient. When an intestinal resection is going to be performed the intestinal lumen is occluded with tapes above and below the tumour to prevent intraluminal spread of cancer cells during manipulation of the tumour.15 A solution containing 10 mg. of nitrogen mustard in 500 c.c. of physiological saline is freshly prepared. An adequate amount of the solution to distend the gut (about 100 c.c. at each site) is injected into the lumen above and below the tapes. Resection is then performed and the fluid is sucked out from the lumen of the gut just before the anastomosis is completed. A second solution of nitrogen mustard (0.3 mg./kg. body weight) is freshly prepared in physiological saline to give a concentration of 2.5 mg, of nitrogen mustard per 100 c.c. of physiological sali ie, e.g. a 150 lb. man below 70 years of age would receive 20.5 mg. of nitrogen mustard in 818 c.c. of physiological saline. patient is given more than 25 mg. of nit ogen mustard. The solution is inserted it to the peritoneal cavity before closing the peritoneum. The operative wound is washed with the fluid and the intestines are moved around to disseminate the fluid thoroughly. The fluid is left in the peritoneal cavity. A ter abdomino-perineal resection of the rectum the perineal wound is irrigated with a solution containing 10 mg. of nitrogen mustard in 500 c.c. of physiological saline. A ter operation the white cells and platelets are counted on the first, fourth, seventh and 14th days after operation. Antibiotics are given if the white cell count falls below 400 cells per c.mm. Periodic blood hæmate crit readings are made and blood is given if the hæmatocrit level falls.

#### 2. "Palliative" Series

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Patients are given nitrogen mustard as described for the "attempted curative" series if cancer tissue remains after operation. The residual cancer tissue may either be local, in the lymph nodes, peritoneum, or liver or elsewhere in the body.

In view of the finding that nitrogen mustard could be used without serious complications developing, and that it was possibly of value to the patients, it was decided not to run random selected control and treated series of patients. Each patient who receives nitrogen mustard is controlled by a similar type of case treated by the same surgeon before the onset of this investigation. All the cancer operations performed by a particular surgeon during the preceding two years are listed as curative and palliative according to the operative report and the pathological findings. A patient with a tumour at the same site is selected at random to act as a control for the patient who has received nitrogen mustard at operation. For comparison of results, a similar follow-up period is used for both patients.

#### PRELIMINARY RESULTS

Twenty-six patients suffering from gastrointestinal cancer have been treated with nitrogen mustard at operation. Sixteen were in the "attempted curative" series and 10 in the "palliative" series. None of the patients has developed any serious complication directly attributable to the nitrogen mustard. The severe nausea and vomiting frequently seen after the intravenous injection of nitrogen mustard do not occur when the drug is introduced into the peritoneal cavity at operation. The patients who receive nitrogen mustard are occasionally more ill than would be anticipated from the extent of the procedure performed; however, in none has the general condition of the patient been a cause for anxiety. All of the incisions have healed by primary union. Subacute intestinal obstruction occurred in one of the patients, necessitating operation 10 days after the introduction of nitrogen mustard into the peritoneal cavity. The obstruction was found to be due to a rotation of the gut at the site of the intestinal anastomosis and there was no evidence of a plastic peritonitis. The white cell count increased during the two to three days after operation and fell to its lowest level by about the seventh day. The lowest white cell count so far recorded is 3100 cells per c.mm.

#### COMMENT

The results of giving nitrogen mustard to rats at the time of injecting cells of the Walker 256 tumour suggest that the drug may be of value in patients when administered at operation. However, the Walker 256 tumour can no longer be considered a spontaneous tumour; its cells are therefore more likely to be controlled by nitrogen mustard than are those of a spontaneous or chemically induced tumour. The preliminary clinical results by Cole show a lower incidence of cancer recurrences in patients receiving the drug than in the untreated controls. However, the series is too small to be of statistical significance, and it is emphasized that the method must still be considered experimental.

#### SUMMARY

Preliminary clinical results by Cole suggest that nitrogen mustard given intraportally, intraperitoneally and by the systemic venous route at the time of operation for cancer may decrease the number of cancer recurrences. Experimental work by Collier et al. and McCredie and de Peyster using the Walker 256 tumour in rats suggests that nitrogen mustard may be more effective when possible sites of cancer cell contamination are irrigated with nitrogen

mustard and when the drug is left in the peritoneal cavity. A clinical investigation has been undertaken irrigating possible sites of cancer cell contamination (lumen of the gut and the perineal wound after abdomino-perineal excision of the rectum) with the drug (10 mg. nitrogen mustard in 500 c.c. of physiological saline). In addition nitrogen mustard (0.3 mg./kg. body weight at a concentration of 2.5 mg. in 100 c.c. physiological saline) is left in the peritoneal cavity. The white cell and platelet counts are recorded before and after operation. Twenty-six patients have so far been treated: 16 in the "attempted curative" series and 10 in the "palliative" series. None has developed any serious complication attributable to the nitrogen mustard. The white cell count increased during the first two to three days following operation and then decreased to its lowest level between the seventh and 10th days. The results show that it is safe to use nitrogen mustard locally and by the intraperitoneal route at the time of operation; however, it is emphasized that the method is experimental and not vet adoptable for general use.

I would like to thank Dr. W. H. Cole of the University of Illinois, Dr. A. D. McLachlin of the University of Western Ontario, Dr. Ivan H. Smith, Dr. W. R. Inch and Dr. W. B. Barton of The Ontario Cancer Foundation. London Clinic, for encouragement in this work and especially the convergence of London Ontario for this permanent. surgeons of London, Ontario, for their co-operation and interest in this investigation.

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#### RÉSUMÉ

Les premiers résultats cliniques de Cole montrent que le gaz moutarde (mechloréthamine chlorhy-drate) administré par les voies intraportale, intrapéritonéale ou intraveineuse peut, lors des actes chirurgicaux dans les cas de cancer, réduire le nombre des récidives carcinomateuses. Le travail hombre des rectuives carchiomateuses. Le travail expérimental accompli par Collier et ses collaborateurs, par McCredie et de Peyster sur les tumeurs Walker 256 du rat, tendent à montrer que le gaz moutarde est plus efficace si l'on peut intrinsure disrectueurs, passe les peuts des peuts de les peuts de irriguer directement avec la substance les points de contamination possibles, et si l'on laisse la drogue dans la cavité péritonéale. C'est ainsi que fut entreprise une série d'essais cliniques, au cours desquels des lieux supposés capables d'être contaminés par des cellules cancéreuses, furent directement irrigués avec une solution de gaz moutarde (10 mg. de gaz moutarde dans 500 c.c. de solution contamination supposée étaient la lumière intes-tinale et l'ensemble de la plaie périnéale lors d'une résection abdomino-périnéale du rectum. De plus resection andomino-perineaie du rectuiii. De plus une certaine quantité de la même drogue fut laissée dans le péritoine, ceci à raison de 0.3 rig. par kg. de poids corporel. Les numérations de plaquettes furent effectuées avant et après l'internations de plaquettes de l'internations de plaquettes de l'internations de plaquettes de l'internations de plaquettes de l'internations de l'interna vention. Vingt-six patients furent soumis à ce traitement, dont 16 formaient un groupe de cas viaisemblablement curables et 10, un ensemble de cas traités palliativement. Aucun n'a souffert de complications ou de troubles directement at ri-buables à la drogue. Le nombre des éléments de la série blanche augmenta pendant les deux ou trois premiers jours post-opératoires et il est descendu à son taux le plus bas vers le 7ième ou le 10ième jour. Dans l'ensemble, il est possible de considérer comme non dangereux l'emploi de moutarde dans ces conditions; cependant. méthode est encore au stade d'essai et ne doit as être généralisée avec trop de hâte.

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References should be referred to numerals in the text and should be set out in accordance with the Cumulative Index Medicus abbreviation of journal name and general style. They should include in order: the author's name and initials in capitals; title of the article; abbreviated journal name; volume number, page number and year. References to books should include in order: author's name; title of book; title of publishing house; city of publication; number of edition (e.g., 2nd ed.); year of publication.

#### Illustrations

A reasonable number of black-and-white illustrations will be reproduced free with the articles. Colour work can be published only at the author's expense. Photographs should be glossy prints, unmounted and untrimmed, preferably not larger than 10" x 8". Prints of radiographs are required and not the originals. The magnification of photomicrographs must always be given. Photographs must not be written on or typed on. An identifying legend may be attached to the back. Patients must not be recognizable in illustrations, unless the written consent of the subject for publication has been obtained. Graphs and diagrams should be drawn in India ink on suitable white paper. Lettering should be sufficiently large that after reduction to fit the size of the Journal page it can still be read. Legends to all illustrations should be typed separately from the text and submitted on a separate sheet of paper. Illustrations should not be rolled or folded.

#### Language

It should be clearly understood that contributors are at full liberty to submit articles in either English or French, as they please. Acceptance will be quite independent of the language of submission. If the contributor wishes, he may submit an informative summary of not more than 300 words in the language other than that in which he has submitted the article. For example, an article in English must carry an English summary and may, if the author wishes, carry a more detailed summary in

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#### DEVELOPMENT IN TORONTO'S MEDICAL FACULTY

More space and better facilities for important research projects will be provided as the Faculty of Medicine's share in the University of Toronto's current development program.

Substantial renovation and additions to medical buildings are included in the first stage of the University's program, to cost \$52,359,000 during the next five years. Of this sum, \$12,600,000 is now being sought from public sources by means of the National Fund for the University of Toronto, and many thousands of volunteer committee members were out during the month of November carrying the appeal to alumni in all faculties and colleges, and corporate and individual friends of the University.

A sum in excess of \$2,000,000 has been allocated for renovation and major additions to the Faculty of Medicine's present research buildings. Through foresight in their original conception and construction, both the Banting Institute (built in 1932) and the Best Institute (opened in 1955) have sufficient foundations, steel and heating facilities for the proposed additions, which will provide space for research in cardiovascular surgery, medicine, pathology and other fields and allow for modernization and air conditioning of new animal quarters. Also planned is major rearrangement of the Biology Building, to be vacated by zoology students, and portions of the Hygiene Building. This will enable women students to vacate the makeshift wartime huts on Hoskin Avenue.

Although student enrolment has for the past ten years, been restricted to 150, the maximum number considered desirable and practicable, some new teaching facilities will also be provided to allow for broadening of some courses and for admission of greater numbers of students from other related faculties such as nursing, dentistry, and pharmacy. It will also allow reorganization of the whole field of rehabilitation medicine. Courses in physical and occupational therapy have been given for some years, and last year a course in speech

pathology was added, but now the whole subject of rehabilitation medicine, still comparatively in its infancy, is to be reorganified and formalized with facilities which will be, in the words of Dean J. A. MacFarlane, "the equal of any on the continent".

Another important project to be initia ed by the Faculty is a far reaching investigation into the whole subject of the teach ng of medicine which will study such aspects as curriculum, relationships with the teach ng hospitals, how the public and the community can best be served, and the whole subject of the practice of medicine. Behind the study is the ultimate question-how to accommodate the growing number of applicants for medical courses when a great number of universities have been forced to limit their enrolments. Expansion at Toronto, which enrols more than twice as many students as some other Canadian universities, is out of the question, but a proposal that the Faculty divide into three clinical schools attached to each of the teaching hospitals is under consideration.

"The most important thing to be derived from the Faculty's participation in the development program is the boost it will give research," Dean MacFarlane says. "Toronto's contributions to world medical knowledge are well known and it is important that this work be carried on in the best possible conditions. Several important research projects are now in progress at a great disadvantage in inadequate space. Among them is Dr. W. G. Bigelow's work on certain aspects of open-heart surgery, the study of a simple way of inducing hypothermia by studying the hibernation of animals and also his studies in the transplantation of blood vessels.

"We also have an obligation in the encouragement of research. The Faculty has always been closely allied with the teach ng hospitals, all of which have recently expanded to provide tremendously increa ed clinical facilities. The University must now provide the same type of teaching and research facilities at the basic science lev 1."

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#### BOOK REVIEWS

SURGERY OF THE PROSTATE. Henry M. Veyrauch, Stanford University School of Mediine. 535 pp. Illust. W. B. Saunders Company, hiladelphia and London, 1959. \$15.00.

During the past 50 years many surgical technic ues have been developed for the removal of the prostate gland. The advantages and disad antages of each of these have been criticall assessed through the years, so that today there remain four standard routes for the reme val of the gland. Keeping pace with the im provement and standardization of operative techniques have been the advances in preoperative assessment of the surgical patient as well as his postoperative care. Surgery of the Prostate by Dr. Weyrauch represents the crystallization of the author's vast experience wi h all four routes for prostatectomy. In addition to a detailed description and appraisal of the various techniques, the book contains many personal observations and suggestions by the author.

The book can be divided into three sections. In the first, general information referable to prostatic disease is discussed. This section includes chapters on anatomy, pathology, and diagnosis of prostatic obstruction. The chapter on surgical pathology is especially impressive because of its completeness and clarity. Several of the section pathology is especially impressive because of its completeness and clarity.

of the colour photographs however are poor. The second section is devoted to surgical techniques. Before these techniques are described, individual chapters are devoted to indications for operation, choice of operation, preparation for operation, anæsthesia in prostatic surgery, and general principles of prostatic surgery. The chapters devoted to the actual techniques for prostatectomy (suprapubic, perineal, retropubic, transurethral) comprise the major portion of the book and are complete. Step-by-step descriptions supplemented by many clear drawings make for complete coverage of the individual techniques. The author also describes the pitfalls that may arise during surgery, and advises on methods of correction.

The third section is made up of two chapters—a detailed one covering postoperative care and treatment of complications following prostatectomy, followed by a brief concluding chapter on the future of prostatic surgery.

The assembly of current knowledge on prostatic surgery in book form is most welcome, and Dr. Weyrauch is to be complimented for the expertness with which he has accomplished his mission. By virtue of a single author's description and appraisal of the four techniques for prostatectomy, the reader obtains the proper perspective to prostatic surgery rather than one biased by individual preference. The inclusion of Dr. Weyrauch's personal observations and helpful suggestions adds considerably to the usefulness of the text. The book

is informative, complete, and the material clearly presented. Surgery of the Prostate can be recommended unreservedly to anyone interested in prostatic surgery.

THE MANAGEMENT OF FRACTURES AND DISLOCATIONS, Vol. I and Vol. II. Anthony F. DePalma, Jefferson Medical College, Philadelphia, Pa. 960 pp. Illust. W. B. Saunders, Company, Philadelphia and London, 1959. \$35.00.

This two-volume atlas of sketches depicts all the various types of fractures met with in the human body, except those involving the face and skull. The text has mostly been used to explain and complement the illustrations, and is mainly in the form of tabulated maxims emphasizing what is important in clinical management, and giving a brief review of such salient features as mechanism of occurrence and incidence.

While these two volumes would be of great interest to students and practitioners, their greatest value might be to the postgraduate student actively engaged in the study of the management of fractures in a traumatic service of a hospital. The excellent line drawings make it possible to find comparative fractures, and to learn how Dr. DePalma would treat them. The text points out the possible complications, and tells how they can be avoided. In addition to fracture management, basic principles in the physiology and pathology of bone healing are described and illustrated, and the various types of pathological fractures are shown.

This set of books would be a useful addition to the library of any hospital whose staff are actively engaged in the treatment of fractures.

DERMATOLOGIE UND VENEROLOGIE einschliesslich Berufskrankheiten dermatologischer Kosmetik und Andrologie: Band III, Teil 1. (Dermatology and venereal diseases, including occupational diseases, cosmetic dermatology and genital disorders in the male: Vol. III, Part 1). Edited by H. A. Gottron and W. Schönfeld, 695 pp. Illust. Georg Thieme Verlag, Stuttgart, W. Germany; Intercontinental Medical Book Corporation, New York, 1959. \$42.40.

The latest edition of this well established German textbook of dermatology and venereal diseases contains several new sections. There is a very brief discussion of hæmorrhoids, and a few paragraphs on an interesting phenomenon which appeared last winter in Germany. This is the so-called "new disease" which spread in epidemic fashion throughout Germany, Holland, Switzerland and other parts of Europe, and was characterized by polymorphic skin and mucosal lesions, pruritus and often initial fever and pain in the neck. It is presumed to be a virus infection related to erythema exudativum multiforme.

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In view of the present tendency to neglect clinical diagnosis for therapy, Schönfeld has inserted new sections on the indications, contraindications and side-effects of antibiotics, sulfonamides, hormones and vitamins. The book continues as a useful guide to practical dermatology.

BRONCHOGRAPHY. C. Dijkstra, Medical Superintendent of De Klokkenberg Sanatorium, Breda, Netherlands. 157 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959. \$11.50.

The author begins this monograph by outlining the hazards of bronchography and the contrast media used; only the technique of bronchography employed by the author is described. The nomenclature is that used in the British Isles and Europe rather than the international nomenclature or that of Huber-Jackson.

A series of case histories with illustrations of bronchograms are presented to show the value of bronchography in the diagnosis of various chest lesions. Lesions are described in association with intrapulmonary foreign bodies, malignant pulmonary lesions, chronic granulomatous inflammatory lesions of the lung (tuberculosis, silicosis, sarcoid of Boeck), acute and sub-chronic abscess-forming and non-abscess-forming pneumonic disease of the lung, chronic bronchitis, emphysema and/or bronchial asthma and finally bronchiectasis.

The author has selected interesting case histories, apparently out of several thousand patients seen in his hospital. The bronchograms used to illustrate these diseases are excellent reproductions. It is the reviewer's impression, however, that too much emphasis has been placed on importance of bronchograms alone in the diagnosis of chest lesions. For example, bronchograms are only occasionally of value in the diagnosis of intrabronchial foreign bodies. In fact, the author admits that a bronchogram of a foreign body may be indistinguishable from that of a bronchogenic carcinoma.

The reviewer has found this monograph most interesting, especially from the standpoint of well-prepared and well-illustrated case histories. On the other hand, it is essentially a review of case histories and, because of this, its use as a reference text is limited.

THE HAND: ITS ANATOMY AND DISEASES. John J. Byrne, Boston University School of Medicine. 384 pp. Illust. Charles C. Thomas, Springfield, Ill.: The Ryerson Press, Toronto, 1959. \$11.50

In this excellent monograph, the author gives concise but very thorough coverage to all facets and considerations in surgery of the hand. A good review of salient anatomical features as well as embryology is presented in a very readable form. Here, as elsewhere throughout the book, many illustrations are to be found.

After setting down the general principle in treatment of hand infections the various bacteriological factors are considered. This section in particular presents material which is also useful in the understanding of infections elsewhere. The chapter on anatomical localization outlines the areas where suppuration can be expected to collect and the incisions to be used.

Part III deals with general principles of tramato the hand, with a detailed study of injuries to the skin, tendons, nerves, bones and joints. The reader is reminded of the extreme importance of proper handling of these cases and of the tree endous financial burden produced by often lengthy or permanent disability.

In Chapter 8, a good review of the histo pay and methods of tendon healing is presented. This author also cautions that the commonest mis ake of the beginner in this field is to waste time trying to operate through an inadequate incision. Freference is given to the Bunnell zigzag suture, and the method is described. Just what should be done in the various regions of the hand is also of vital importance to the ultimate prognosis. In a similar way, the various considerations in nerve injuries are outlined.

What may appear as a rather trivial bone or joint injury is often poorly treated with resultant substandard functional results. Any doctor dealing with such injuries is bound to pick up some useful tips by perusing this section.

Special injuries such as thermal and radiation burns are referred to briefly, as well as other relatively less common curiosities such as beryllium granulomas and grease gun, aerosol bomb and porcelain faucet injuries. The bibliography on which these are based is detailed and would make a good source of references.

The reader will undoubtedly find the chapter dealing with fibrous hyperplasia interesting reading; it also provides the latest concepts in pathology and treatment of Dupuytren's contracture and stenosing tenosynovitis. An excellent description with beautiful illustrations is given to the many tumorous conditions which can affect the bony and soft tissues of the hand. This section contains numerous fascinating terms and definitions such as paraxial hemimelia, acheiria, pseudoainhum, symphalangism, hyperphalangism and streblomicrodactyly.

The various manifestations of the different vascular diseases and ischæmic muscular contraction are discussed, as well as the latest concepts in treatment. Useful tips in plastic und reconstructive surgery of scars and various deformities are to be found in the closing p: ges so that all in all the book deserves wide us ge.

BREAST CANCER: (Factors Modifying Progn sis) A. J. Delario, New York Cancer Research Institute. 208 pp. Illust. The Macmillan Comp ny, New York; Brett-Macmillan Ltd., Toronto, 1 59. \$7.50.

Dr. Delario presents a personal follow-up of 65 patients with breast cancer admitted to St.

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y, 9. Joseph Hospital, Paterson, New Jersey. They vere followed up for a minimum of four years, and he compares the results in this series and the factors influencing prognosis with those of r any published reports.

The main contributions of the book are found in the discussions on three main aspects: (1) I cognosis after simple mastectomy and postoperative irradiation versus that after radical mastect my and postoperative irradiation; (2) prognosis in relation to different surgical techniques used; (3) the influence on prognosis of other fotors.

Regarding the controversial issue in (1), Dr. I elario has this to say: "The body's natural frees with the help of radiation can destroy the war cancer cells left behind in the breast area and a illa after a radical operation a lot better and with smaller doses of radiation, than it can the larger organized masses of cancer cells left in the axilla after simple mastectomy." He underlines this opinion by stating that McWhirter who espouses simple mastectomy and radiation, gives too low a figure (32.4%) for a five year survival after radical mastectomy plus postoperative radiation, and quotes his own figure of 60.2% in 83 patients.

Concerning surgical techniques, Dr. Delario states that removal of the pectoralis minor muscle is mandatory for complete axillary dissection, and that the dissection must be made in one block. In his new series, the results in the later period seem to suggest improved surgical techniques. He quotes various sources to suggest strongly that supra-radical operative procedures such as removing supraclavicular and internal mammary lymph nodes do not alter the prognosis. Dr. Delario agrees that the greater the amount of breast skin removed, the better the cure rate and the fewer the recurrences, although the number of cases in his series in which size of skin area was measured is too small for statistical analysis.

In his discussion of various other factors influencing prognosis, he lays great emphasis on axillary node metastases, the histology of the lesion, the grade of malignancy and the quadrant of the breast involved. The one factor having the greatest bearing on prognosis in breast cancer apart from adequate surgery and postoperative irradiation seems to be the presence or absence of lymph node metastases, although there are exceptions, as where a high degree of malignancy without node metastasis proves to be associated with a shorter survival time than the tabulated one.

In conclusion, one may say that the statistics of these 465 cases are carefully documented and analysed, and they have the added value that all cases were personally studied and followed up by Dr. Delario. There is an exclusive review of results of the most prominent workers in this field, and one feels that this is a valuable book for every medical practitioner interested in this common disease, carcinoma of the breast.

ANALGESIE PSYCHOLOGIQUE EN OBSTE-TRIQUE (Psychological Analgesia in Obstetrics). Edited by P. Aboulker, L. Chertok and M. Sapir, 172 pp. Pergamon Press, London and New York, 1959, \$9.00.

Ce livre contient des travaux présentés à une journée d'études tenue à Paris, le 7 avril 1957. Les problèmes médicaux liés à l'analgésie psychologique furent évoqués par plusieurs spécialistes de différents pays. On traita aussi des bases théoriques ainsi que des différentes techniques au cours de cette assemblée.

Dans l'introduction, H. de Watteville déclare que si cette méthode de l'accouchement naturel a tendance à gagner du terrain, il s'en faut de beaucoup pour que nous soyons rendus au point où elle soit reconnue comme une doctrine scientifique établie et universellement acceptée. J. de Ajuriaguerra, de Paris, affirme à l'aide d'une bibliographie importante, que l'attitude envers la douleur dépend de variations biologiques et du tempérament; dans certaines circonstances, un sujet normal peut prendre une attitude particulière, face à la douleur, attitude qui modifie soit le seuil de la souffrance, soit le type de réactivité secondaire au stimulus nociceptif.

Au second chapitre, Chertok décrit les deux méthodes connues d'accouchement naturel et fait part des opinions positives connues à date sur l'analgésie psychologique. Lamaze et Vellay décrivent l'expérience acquise après cinq ans d'usage de cette méthode psycho-prophylactique et les moyens qu'ils ont mis en œuvre pour en faire une réussite plutôt qu'un échec, appuyant surtout sur l'énoncé des différentes motivations qui préparent au succès. A leur suite, Lepage, Langevin, Droguet et Zaidman, racontent avec preuves à l'appui en quoi a consisté la préparation psychique et physique à l'accouchement naturel, après un recul suffisant pour qu'elle ait une certaine valeur scientifique.

Les chapitres qui terminent ce très intéressant volume permettent à des auteurs français, suisses, espagnols et portugais, d'apporter leur contribution à des opinions qui se ressemblent par leur principe de base et qui ne diffèrent souvent que dans les détails de leur application.

Si ces opinions sont acceptées on verra réapparaître les à-côtés de l'accouchement qu'ont connus nos devanciers: la présence du mari dans la salle d'accouchement, l'absence aussi complète que possible de toute analgésie et la préparation psychologique à laquelle ces auteurs attachent plus d'importance qu'à certaines méthodes de laboratoire auxquelles l'éloignement des milieux hospitaliers les empêchait de recourir.

La psychosomatique a pénétré le domaine de l'obstétrique avec les travaux de deLee publiés à Philadelphie en 1944. Il est intéressant d'en suivre l'évolution dans les pages de ce volume, comme il le sera de connaître ce que l'avenir lui réserve car personne ne peut nier la profonde vérité de cette phrase de Couvelaire qui disait, il y a déjà vint-cinq ans: "que la préparation permet de donner aux mères cette source de joie

profonde, d'être les premières à entendre le premier cri de l'être qu'elles ont nourri de leur sang."

RADIODIAGNOSTIC EN OTOLOGIE Roentgen Diagnosis in Otology). Michel Portmann and Georges Guillen, Medical Faculty, Bordeaux, France. 207 pp. Illust, Masson & Cie, Paris, France, 1959, 3,700 FF.

Les auteurs présentent une étude avancée de la radiologie de l'oreille. Les incidences qu'ils décrivent sont expliquées clairement à l'aide de schémas et de photographies de sujets sur la table d'examen et devant le craniographe. On pourrait peut-être leur faire le reproche d'avoir ignoré l'incidence axiale de Mayer qui est de réalisation relativement facile et dont l'interprétation est plus à la portée du radiologiste moyen que celles de Chaussé ou les autres décrites dans le texte. Sans doute ces dernières entre les mains d'experts en la matière sont-elles plus que suffisantes; mais elles sont difficiles à réaliser et à interpréter à cause des variantes individuelles dans l'axe du défilé antro-adito-attical. A mon sens, les radiologistes qui ne sont pas spéciale-ment attachés à un grand service d'otologie sont mieux de se confiner au trépied Schuller— Stenvers—Mayer avec, si possible, l'agrandisse-ment disponible grâce au foyer de 0.3 mm.

Le volume est quand même un apport précieux pour le spécialiste. Sans doute les reproductions gagneraient-elles en lucidité par l'usage du logétron, mais elles permettent aux initiés des diagnostics de grande finesse. J'ai particulièrement admiré la démonstration de fractures diverses du rocher qui, entre nos mains, sont trop souvent classées comme occultes. L'importance médico-légale de telles démonstrations ne peut être exagérée.

Les auteurs ont surtout voulu décrire leurs méthodes d'exploration et ils y sont parvenus avec succès. La partie clinique est sommaire et peu illustrée. On peut espérer qu'un autre volume paraîtra bientôt, consacré à la pathologie de l'oreille et s'appuyant, par des clichés révélateurs, sur ces données techniques dont l'intérêt est indubitable.

OPERATIVE SURGERY: Progress Volume 1958 (and General Index). Edited by Charles Rob and Rodney Smith. Illust. Butterworth & Co. (Canada) Ltd., Toronto, 1958.

The Progress Volume is a somewhat smaller book than preceding members of this series. It consists of one hundred pages of descriptions of progress in various subjects and seventy odd pages of general index. The progress section deals with a variety of subjects from surgery of the pancreas, removal of adherent spleen, aortic valvotomy through to exteriorization of a pilonidal sinus. Ten subjects are discussed at some length. Shirodkar's operation for recurrent abortion in mid-pregnancy due to incompetence of the cervix

is described in detail. The authors point out that the mode of delivery when fascia has been used to encircle the cervix should be by Cæsarean section. The reviewer doubts the efficacy of vaginal delivery which they suggest when further pregnancies are desired.

It is curious to find exteriorization of a piloni al sinus as a progress item. This procedure is alrealy in the armamentarium of surgeons in this count y.

Notwithstanding the above, this little edit in will prove a useful adjunct to owners of the complete series. The index is based on "region", specific operations and authors of sections and is a ready reference to preceding volumes. The binding and format are in the usual good ta te of the complete series.

MODERN TRENDS IN DISEASES OF THE VERTEBRAL COLUMN, Edited by Reginald Nassim and H. Jackson Burrows. 292 pp. Illust. Butterworth & Co., London and Toronto, 1959, \$15.00.

This volume is a welcome up-to-date compilation of the many aspects, both recent and old, of the ever increasing disorders associated with the back and vertebral column. The subject matter related to the vertebral column includes anatomy and development, congenital anomalies, degenerative diseases, tumours, spinal cord injuries, low back pain, radiological aspects, osteoporosis, spinal biopsy, as well as a variety of other topics.

Each chapter is complete in its own subject and the authors are well known authorities in their respective fields. The text is well illustrated and generally fairly complete. Although the topics are primarily of orthopædic interest, the scope is sufficiently widespread to be of interest to other physicians, including internists, neurologists, and neurosurgeons, as well as the general physician. The book should serve as an up-to-date authoritative account of the diseases of the vertebral column and closely related structures.

TEXT-BOOK OF SURGERY. Edited by H. F. Moseley, 1158 pp. Illust. 3rd ed. H. K. Lewis & Co. Ltd., London, 1958; C. V. Mosby Company.

As a result of a questionnaire sent to many teachers in the United States and Canada, and stimulated by the rapid changes in surgery, an extensive revision has occurred in the third edition of Moseley's Surgery. A new chapter, a) written, has been added on cardiac surgery and several amplifications in other branches have peared. New, nicely reproduced colour plates adorn this volume and are very welcome.

This surgical textbook has become establisled as one of the best Canadian offerings, challeng ng any from Great Britain or the U.S.A. It can proudly occupy a place beside Boyd's *Patholo yy*, Grant's *Anatomy* and others.

(Continued on page 190)

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(Continued from page 188)

EMERGENCY WAR SURGERY—NATO HAND-BOOK. Canadian edition distributed by the Department of National Defence, Ottawa. 411 pp. Illus.:

This valuable publication was developed by a NATO Committee of consultants in an effort to standardize various military surgical methods. The scope covered in such a concise manual is truly remarkable. For this reason it is bound to provide a useful source of material for many medical practitioners besides those who specialize in medico-military surgery. In addition, it will serve as a reminder of useful principles and practices that usually come to light only in time of war but can be usefully applied to civilian medicine.

After an introduction into general considerations of forward surgery and pathomechanics of wounds caused by missiles the authors go on to discuss thermal burns, crush, blast, chemical and radiation injuries. Although the chapter devoted to burns is quite adequate, no new or startling concepts are introduced. That devoted to cold injury is very well done and one would have difficulty finding any more complete coverage in such an assimilated form.

The subject of shock and resuscitation is dealt with in a very thorough manner. Artificial hibernation accomplished by the administration of pharmacologic agents which inhibit the function of the autonomic nervous system at d thus reduce cellular metabolism and oxyg n exchange is described. Although useful in the care of casualties it must not be employ d unless trained personnel expert in its administration are available (at all levels of evacuation).

Newer concepts in metabolic response of injury are considered including electrolyte blance and acute renal insufficiency, both of which are so important in traumatic surgery of today. The bacteriology of surgical infections is treated very superficially but contains some useful information on antibiotic therapy. The importance of early and adequate wound differentiation between clostridial myositis and anaerobic cellulitis, anaerobic streptococcic myositis and anoxic gangrene are presented. The notes on tetanus, although brief are up to date and could spell the difference between life and death.

Each chapter has notes on methods of dealing with mass casualties as well as the individual case. However, the section on sorting of casualties and the scope of treatment to be given at different echelons will be of interest even to the civilian surgeon who might wish to give some thought to his responsibilities in event of disaster.

A good but concise description of the method of debridement is outlined with stress on the importance of removing all devitalized tissue.

# MODERN TRENDS IN ACCIDENT SURGERY AND MEDICINE

By F. G. Badger, B.Sc., F.R.C.S. (Ed.), Consultant Surgeon, Deputy Clinical Director, Birmingham Accident Hospital, the late RUSCOE CLARKE, M.B.E., M.B. (Lond.), F.R.C.S. (Eng.), Surgeon, Birmingham Accident Hospital, Secretary, Institute of Accident Surgery and SIMON SEVITT, M.D., M.Sc., M.A., F.R.C.P.I., D.P.H., Consultant Pathologist to the Birmingham Accident Hospital and M.R.C. Burns Research Unit.

\$15.00

The Birmingham Accident Hospital is unique since it is the only hospital in the British Isles which deals with accidents, to the exclusion of every other type of case. A book emanating from such a centre must inevitably be equally unusual and this new work, where the editors and all the contributors are, or have been, members of the staff, is the outcome of years of experience concentrated on the surgical treatment of every conceivable type of accident.

## BUTTERWORTH & CO. (CANADA) LIMITED

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Thorough exploration for damaged tissue is a ways important but especially so in suspected a terial wounds. A relatively comprehensive coverage is given to this specialty because of the rapid advances which have recently been made. While the majority of major arterial injuries can be repaired by direct anastomosis me will require graft. Because of availability the authors would seem to prefer the autogenous vein graft. It is too bad that a word his not been said about some of the newers at thetic prosthesis such as dacron and crimped in lon or their counter-parts which surely will be employed more and more in the future. Associated fractures naturally complicate the hindling of these wounds. If a limb is placed in traction after repair, it must be kept under constant observation to insure that no damage is being done to the anastomosis.

The considerations of peripheral nerve injuries and amputations although both brief concur with the current accepted methods. Much controversy has arisen in the past as to the relative advantages of open flap versus circular amputation. Although the latter may be safer for routine use in cases of mass casualties, the advantages of the former must not be forgotten.

(Continued on page 192)

#### Books Received

Books are acknowledged as received, but in some cases reviews will also be made in later issues.

Clinical Prosthetics for Physicians and Therapists. A Handbook of Clinical Practices Related to Artificial Limbs. Miles H. Anderson, Director Prosthetics Education Project; Charles O. Bechtol, Professor of Surgery (Orthopædics); Raymond E. Sollars, Associate Director Prosthetics Education Project, University of California. 393 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959. \$11.50.

Cancer of the Breast. Edited and compiled by Willard H. Parsons, Chief of Staff and Director of Surgery, Vicksburg Hospital and Clinic, Miss. 232 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959. \$8.25.

A System of Orthopædics and Fractures. A. Graham Apley, Consultant Orthopædic Surgeon, the Rowley Bristow Orthopædic Hospital, Pyrford, Surrey. 357 pp. Butterworth & Company Limited, London; Butterworth & Company (Canada) Ltd., Toronto, 1959. \$9.50 (Interleaved edition \$13.50).

Pediatric Neurosurgery. Edited by Ira J. Jackson, Assistant Professor of Neurosurgery, University of Texas Medical School, Galveston, Texas, and Rymond K. Thompson, Assistant Professor of Neurological Surgery, University of Maryland School of Medicine, Baltimore, Maryland. 564 pp. Il ust. Charles C Thomas, Springfield, Ill.; The R erson Press, Toronto, 1959, \$18.25.

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(Continued from page 191)

SYMPOSIUM OF TREATMENT OF ANORECTAL DISEASES. Stuart T. Ross, Diplomate of the American Board of Proctology and Secretary of the American Board of Proctology. 240 pp. Illust. The C. V. Mosby Co., St. Louis, Mo., 1959. \$6.50.

This is a very timely and much needed book on a condition which is met with very frequently in the office practice of the general practitioner. To him it should be a great boon, as it contains in adequate detail a description of all of the common and some not so common conditions affecting the anus and rectum. Enough description of anatomy and physiology is given to ensure a clear understanding of the conditions, and the treatment advised in each case is very practical.

The medical student, intern or resident should find the orderly fashion in which the different conditions are dealt with a great help to him in understanding this subject. Previously he had to search through many articles to get a reasonably clear understanding of what the little volume presents in a very readable and concise form. Even the proctologist and general surgeon will find it of much practical value. This book is recommended as an addition to the library of all who are interested in any way in this particular field of medicine.

CHANGE OF ADDRESS

Subscribers should notify the Canadian Medical Association of their change of address *two* months before the date on which it becomes effective, in order that they may receive the Journal without interruption.

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#### HISTORY OF SURGERY

#### FOOT BINDING IN CHINESE WOMEN

H. S. Y. FANG, M.Ch.Orth., F.R.C.S.(E.), and F. Y. K. YU, M.B., B.S., Hong Kong, China

#### NTRODUCTION

Throughout the centuries many famous writings have appeared in literature, both in Chinese and in other languages on the various aspects of foot binding, a remarkable form of fashion that had existed in China for over a thousand years. This article is intended to be a present-day review of this peculiar and unique man-made deformity which is now rapidly becoming obsolete, for women who still possess such deformed feet are on the verge of disappearing completely from our midst.

#### HISTORY

1

There is great uncertainty as to when this custom first started.2, 10 The ancient lyrics mentioned Tangee, wife of the last Emperor of Shang Dynasty, who had her feet wrapped in strips of cloth as early as 1700 B.C. During the time of Confucius, 551-479 B.C. there were paintings of women with small pointed feet. Ssu Ma Chien, the historian of Han Dynasty, 145-85 B.C. described dancers wearing pointed slippers. In the reign of Nan Chi, Tung Kwan Hou, 499-501 A.D. one of the rulers of the Six Kingdom Dynasty 420-589 A.D. the palace floor was inlaid with gold in the shape of the lotus flower. The king had his wife Pan Fei dance on it, and remarked on the perfect similarity of her feet to the floor designs, and hence the name Golden Lotus became common usage in the description of the feet of Chinese women.

The wife of Emperor Ming Huang, 712-755 A.D. of the Tang Dynasty, 618-907 A.D. Yang Kwei Fei, one of the most beautiful women in Chinese history was said to have a pair of feet measuring only three T'sun (approximately four inches). The most

generally accepted belief is that the foot binding practice started in the court of Li Hou Chu, Emperor of Southern Tang, 961-975 A.D. who ordered a court entertainer Lady Yau Niong to have her feet bound with white silk so as to produce a celestial effect as she danced on the stage. During the reign of the Sung Dynasty, 960-1280 A.D. there was already indisputable evidence that foot binding had become a common practice in the north of China.

It seems probable that singing and dancing girls were the first women to start binding their feet and that the practice originated in the palaces and capital cities which were then in the great Asian Plains in the north of China. This spread gradually to the south and the coast and grew into a national custom, principally through the spreading of the news by travelling salesmen, storytellers and minstrels, who wandered from town to town and into the smallest villages.

#### INCIDENCE

Most historians would agree that before the tenth century foot binding practice was rare and sporadic. It slowly became popular among the Imperial household and ladies of the entertainment profession. After the tenth century the practice gradually spread into a national custom. This came to a climax in the Ching Dynasty of the 17th century when nearly all Chinese women had their feet bound.

Rebellious outbursts against such practice, which was considered cruel and impractical occurred periodically even as early as the Sung Dynasty in the 11th century, but these developed into more powerful and organized movements at the end of the Ching Dynasty in the 19th century and it took nearly half a century to finally abolish this deep-rooted custom.

From the Department of Surgery, University of Hong Kong.



## 4 6 6 7 8 9 9

Fig. 1.—This particular pair of bound feet shoes is about 150 years old and had actually been worn by a girl of 12. Notice the raise in the heel (numerals represent inches).



Fig. 2.-Bound feet shoes viewed from the top.

#### PROPAGATION OF THE CUSTOM

It is truly remarkable that such a painful and difficult practice could exist for over a thousand years. Our own views are summarized as follows.

#### 1. Beauty and Fashion

Women have always been considered the

fairer sex and all that is delicate, soft and slender is associated with them. Thus a pair of small slender feet have always been a symbol of feminine beauty and fairness. Feet that had undergone binding accentuated these qualities. Moreover, because of the binding, shoes required a raised heel, and women with such feet were said to move much more slowly and softly, with additional grace and dignity, and so despite hardships and pain, foot binding rapidly became a great fashion amongst Chinese women.

The praise of bound feet is well illustrated in a poem by Su Tung Po, a poet of Sung Dynasty, described by Lin Yutang (a contemporary Chinese author) as the "Gay Genius". He wrote ". . . the beauty of their slender shapes and their charms are beyond human words; they would be better appreciated if she danced on the palm of your hand." Indeed the foot binding practice had developed into a great art. It was recorded that in the Ching Dynasty, in the cities of Lan Chow and Tai Tung in the north of China, annual contests were held to choose the best shaped bound feet.

#### 2. Social Standard

When this practice became a nation-wide custom it soon developed into an obsession and compulsory accomplishment with t

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women. The shape of feet was considered an essential criterion in the judgment of beauty. And because of the fact that before the turn of the present century Chinese marriages were customarily the result of prearrangement, directly or indirectly between the parents of both parties and not the outcome of love and courtship, girls whose feet were not bound were considered crude and barbaric and could hardly be married off.

#### 3. Submission and Chastity

In ancient Chinese society parents were almighty and men were the masters inside and outside the house. Because bound feet were considered to be an indispensable accomplishment, parents carried out what they themselves thought was best for their daughters, despite their tears and cries. Women with bound feet could hardly walk and so they had to stay indoors. Thus were they kept out of temptation and mischief as the men so desired. This is probably not one of the primary objects for the introduction and propagation of the foot binding practice.

#### MORBID ANATOMY

#### The External Features

The contour of bound feet of Chinese women is not unlike the acquired type of calcaneo-cavus foot of paralytic origin. The most prominent part of the foot is the heel. The hindfoot which makes up one-third of the normal foot is here bigger than the forefoot in almost all the dimensions. The normal incline of the forefoot which is about 30° to 40° as measured from the plane of the ankle joint is here acutely bent downwards at the mid-tarsal joints, making an incline of about 60° to 80° so that the heads of the metatarsals are now closely approximated to the heel. As a result the mid-tarsal bones are excessively wedged presenting as a lump over the dorsum of the foot. The sole of the foot is greatly foreshortened and appears as a deep groove or furrow between the forefoot and the heel. The forefoot and all the toes appear attenuated and somewhat mummified. The big toe tapers gradually to its tip and is



Fig. 3.—A lotus flower bud. Notice the similarity between this and the bound foot.

usually inclined outwards (hallux valgus). The first metatarso-phalangeal joint is dorsi-flexed to about 30°. The outer four toes are bent and flexed under the sole to a different extent along an imaginary line joining the base of the 5th metatarsal to the tip of the big toe, so that the forefoot is shaped like an inverted cone, with the tip of the big toe at its point.

On standing, the forefoot which is being acutely flexed downwards is usually at a lower level than the heel, and this accounts for the necessity of wearing raised heeled shoes or boots. Weight is borne on the heel, the ball of the big toe and the dorsal surfaces of the rest of the toes which are being folded against the sole. The outer border of the foot almost does not exist.

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Fig. 4.—Sole of the bound foot, Notice the clawing of the outer four toes, The little toe is turned 90° from its axis.

#### Skin

The skin covering the forefoot and toes where most of the pressure is exerted in the process of binding, is thin and shiny. There may be scars over the bony points which have resulted from previous ulcerations due to pressure necrosis or circulatory disturbances. The skin of the extensor surfaces of the outer toes is usually cornified because of weight bearing. There is little or no subcutaneous tissue on the dorsum of the foot and the webs of the toes are usually unhealthy and infected.

#### Ligaments

The interosseous ligaments on the dorsum of the foot are thin and attenuated. The Achilles tendon is elongated and stretched into a broad thin band covering the posterior aspect of the ankle joint and is attached to the tuberosity of the cal-



Fig. 5.-The dorsum of the bound foot.

caneum which is being depressed downwards to become the inferior aspect of the bone. The plantar fascia is grossly contracted and shortened. The interosseous ligaments on the plantar aspects are shortened by a process of adaptation during growth. These ligaments are thick and strong and offer great resistance to attempts at restoring the normal form of the foot.

#### Muscles

The intrinsic muscles of the foot show marked atrophy and are almost reduced to fibrous bands. The muscles of the leg are also found to be wasted in dissected specimens.

#### **Joints**

There is marked dorsiflexion of the arkle joint in the erect position. The lower and of the tibia articulates with the ante ior half of the body as well as the neck of the talus. Movement of the ankle join is still remarkably free. There is gross s iff-

ness of the tarsal joints and in dissected specimens, there is evidence of arthritic changes and occasional fibrous ankylosis. The joints of the outer four toes which are acutely flexed into the sole, have adupted to their deformed manner and cannot be straightened, even by force. All the cases that we have examined have some degree of hallux rigidus in the first metatarso-phalangeal joint.

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This will be described in detail under "Radiological Appearance".

#### RADIOLOGICAL APPEARANCE

individual bones of the foot alter but slightly in shape, yet the distortion is considerable. There is a generalized rarefaction as well as thinning of the cortex. The tuberosity of the calcaneum is depressed downwards so that the long axis of the bone is more or less vertical. In the erect position, a woman with bound feet would be standing on the posterior surface of the bone instead of its inferior surface; and the superior surface of the calcaneum comes into alignment with the posterior surface of the tibia. The talus lies almost horizontally and the plane of the ankle and subtaloid joints are almost parallel. The navicular bone articulates with only the lower half of the head of the talus which appears to be subluxated dorsally. The calcaneal or Böhler's angle (the angle made by a line drawn through the subtaloid joint and that along the superior margin of the calcaneum, normally measuring about 40°) is, in this state, widened to over 60°, owing to the downward bending of both the calcaneum and bones of the forefoot. The remaining tarsal bones are markedly wedged inferiorly, so much so that the base of the fifth metatarsal nearly touches the front of the calcaneum. The metatarsal bones are thin and attenuated and each one is shorter than the other proceeding from the first metatarsal outwards, so that the fifth metatarsal is only about half the length of the first. The heads of the metatarsals are closely approximated to the calcaneum. The outer metatarsals are almost vertically placed. The phalanges of the toes, with



Fig. 6a.



Fig. 6b.

Fig. 6a and 6b.—The outer and inner aspects of bound foot.

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Fig. 7.-Lateral view: the calcaneum and the 5th metatarsal are almost vertically placed.

the exception of the great toe, are markedly atrophic and deformed. They are deviated outwards and are acutely flexed downwards and inwards into the sole of the foot.

#### TECHNIQUE OF FOOT BINDING

It is interesting to note that the method used to produce bound-foot since a thousand years ago is very similar to the way modern orthopædic surgeons would correct certain foot deformities. In either instance, the process requires repeated moulding and a long course of strapping and bandaging, except that in the latter, we allow natural growth of the foot to proceed, whereas in the case of bound feet, growth is deliberately restricted and the foot is made to reshape according to its new confinements.

The process of foot binding is started between the ages of two and six years. Girls of richer families start binding earlier in order to achieve as small and as slender a foot as possible. Those of poorer families who would be required to do manual work, would start late so that they would be left with a more useful foot. The materials used are bandages made of silk or cotton, according to the wealth of the family. Each bandage measures one to three inches wide and three to five feet long. Usually, two or more bandages are required for each foot. The size and number of strips required varies according to the size of the foot and the amount of tension to be exerted.

The first stage of the binding process begins with severe moulding and coning of the forefoot. Following repeated manipulations and bandaging over a course of one to two years, the forefoot is being successfully shaped. Then, during the next two or three years, the second stage is carried out. This consists of strongly flexing the forefoot against the heel so that the whole foot is made as short as possible and held in position with bandages applied in the figure of eight manner, holding the heel forcibly downwards.

The process of bandaging is extremely time-consuming and girls of poor families usually have the layers of the bandages stitched after applications and let them

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stay on like a cast for as long as several weeks before re-dressing. The foot-binding process is associated with great pain and anxiety. It is considered a great art to be able to perform the technique with gentleness and comfort. Usually, the womenfolk in families carry out the binding for young girls. Special technicians are employed among the wealthier classes. By the age of 11 or 12, girls usually acquire the art of applying their own bandages. This has to be continued indefinitely throughout life, since the unbound foot loses its accustomed support and becomes painful as a result of strain on the ligaments which have adapted themselves to the deformity.

#### VARIATIONS OF THE BOUND FOOT

Bound-foot varies considerably in size and shape. The length in general ranges from four to eight inches. The smaller ones are less than the length of a man's palm.3.4 The shape also varies greatly, from a simple clawing of the toes to a severe calcaneo-cavus deformity. And in addition, distortions in other dimensions are occasionally resorted to. These are a combination of adduction and abduction, inversion and eversion of the forefoot, either symmetrical or identical in both feet. There are also instances in which the cone-shaped forefoot is being tilted upwards. Apart from these deliberate distortions, women in the present century who have released their bound feet at various stages, have various oddlooking feet according to the degree of previous adaptation of the bones and ligaments of the feet. The latter group makes up the majority of such cases seen in clinics at the present day.

#### COMPLICATIONS AND ILL EFFECTS

#### 1. Circulatory Interference

During the process of binding, especially by inexperienced hands, pressure sores commonly occur, and cases ranging from localized ischæmic necrosis to extensive gangrene which necessitate below-knee amputation have been reported frequently.<sup>7, 8</sup>

#### 2. Infections

On account of the poor hygienic state of



Fig. 8.—Supero-inferior view: notice the inclination of all the toes outward and the marked shortening of the 5th metatarsal.

the feet, fungus infection of toenails and webs of the toes is almost a constant feature. Also owing to the repeated trauma of compression and severe kneading and to the poor nutritional state of the foot, James Maxwell<sup>7</sup> reported a high incidence of tuberculous lesions involving the feet and ankles of women with bound feet.

## 3. Deficiency Diseases and Osteomalacia

Many articles referred to the high inci-

dence and the close relationship of osteomalacia6 and bound feet. The fact that women with such deformed feet seldom get any sunshine as they could hardly go out of doors suggests it is more than mere coincidence that the rate of osteomalacia should be so extremely high in the cities of the great plains of China where footbinding is most enthusiastically practised.

#### 4. The Awkward Gait

In the old bound-feet women that we have examined, there is complete loss of resilience and spring in the gait. They walk with a stamping gait like wearing wooden stilts. They have great difficulty in walking up and down staircases or slopes, and running is almost impossible. As mentioned previously, many of the feet had marked flexion of the forefeet which necessitated the wearing of raised heeled shoes or boots. Although we have not come across any bound-feet women under the age of 30, we feel convinced that when they were young, their gait was much better balanced and poised, otherwise the ancient poets who had written in such great praise of the beauty and grace of the bound-feet gait must have had very poor taste.

#### SUMMARY AND CONCLUSIONS

Foot binding was practised by Chinese women for over a thousand years. It is only since the turn of the present century that this custom has been abolished. The foot was made small, arched and pointed by moulding and tight bandaging, starting at the age of two to six. The primary objective was probably fashion and beauty.

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<sup>\*</sup>From a letter of Joseph Lister to his father, May 27, 1886. Quoted in "Doctors' Legacy", Harper and Brothers, New York.

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#### ORIGINAL ARTICLES

#### TRAUMA TO THE HEAD AND ASSOCIATED OCULAR SIGNS®

F. B. WALSH, M.D. and D. L. KNOX, M.D., in collaboration with R. LINDENBERG, M.D., Baltimore, Maryland, U.S.A.

This paper, originally conceived as the second Wright Memorial Lecture, was delivered in Toronto on October 23, 1959. In the spring of the same year, one of the authors (F.B.W.) presented the May Lecture in New York in which he had gathered basic information on skull fractures and the damage which they may inflict to contiguous structures. The present communication carries the study one step further and deals with injuries to cranial blood vessels and the resulting ocular signs. The authors wish to acknowledge the full co-operation of Dr. Richard Lindenberg¹ whose knowledge of the pathology of the central nervous system is so extensive and who is in such a good position to study traumatic lesions. In this paper the authors have attempted to correlate anatomical and pathological studies with clinical symptomatology; it is not intended to be a review of the literature or a statistical study of the subject.

## FISTULA BETWEEN CAROTID ARTERY AND CAVERNOUS SINUS

ARTERIOVENOUS fistula within the cavernous sinus, essentially an intradural abnormality, is the commonest cause of pulsating exophthalmos. Recently Walker and Allègre<sup>2</sup> reviewed the case histories of 24 patients seen in the Johns Hopkins Hospital; the majority of these patients are known to one of us.

Etiology.—It is generally known that trauma is a factor responsible for rupture of the carotid artery into the cavernous sinus, and that in some instances the artery ruptures spontaneously. From studies on large series by de Schweinitz,3 Sattler,4 Locke,5 the ratio of traumatic to spontaneous cases is usually stated as three to one. In small series this ratio may not obtain. Trauma may result from a blunt or a perforating injury. Blunt injuries frequently are associated with basal fracture when the juxtaposition of the sphenoid bone and the cavernous sinus is important (Fig. 1). Roentgenograms often fail to show the fracture. At times, with or without perforation, the injury has been to the region of the eye and orbit whence fracture is likely to extend into the sphenoid bone. Walker and Allègre remarked on the weakness of the carotid artery in its intracavernous portion as a predisposing factor to rupture. They mentioned Delen's experimental studies in which cannulization of the carotid with forcible injection produced rupture of the artery within the sinus. Rupture of a congenital aneurysm of the carotid within the sinus sometimes accounts for a carotidcavernous fistula and trauma may rupture the aneurysm. Quite often it is impossible to state with certainty that trauma has produced the fistula, and this is true particularly when months have elapsed between the trauma and the onset of signs of fistula. For example, in two severely injured patients we have studied, signs of the fistula developed in one instance seven months after the injury, and years after in the other.

#### PATHOLOGY

The descriptions of Walker and Allègre are adequate and are restated here:

"The pathologic anatomy of carotid-cavernous fistulas may be divided into (1) the changes produced by the abnormal vascular

<sup>&</sup>lt;sup>o</sup>From the Wilmer Institute of the John Hopkins Hospital, Baltimore, Maryland. This work is supported in part by a grant from the U.S. Public Health Service (B2410).

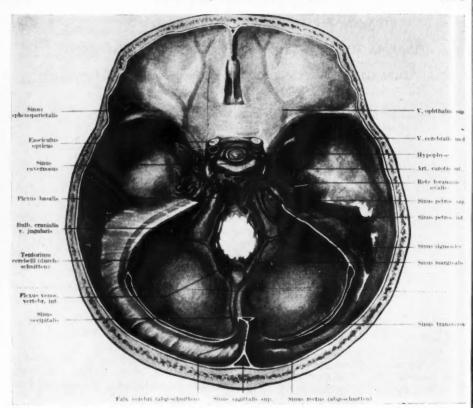


Fig. 1.—Cavernous sinuses and base of skull. Dura has been removed. (Reproduced from Clara<sup>34</sup> by kind permission of the author.)

circulation, and (2) the alterations in the carotid artery itself. As a result of the arterial pressure and pulsation in the cavernous sinus, the latter becomes markedly dilated, its draining channels greatly enlarged and their walls markedly thickened. The cephalic veins going from the sinus, having no valves, become dilated and tortuous. The routes of drainage vary in the individual cases but the most common, as described by Wolff and Schmid, is probably by way of the superior ophthalmic to the angular, facial, and internal jugular veins (Fig. 2). In some cases, however, the path of least resistance is through the petrosal sinus to the basal sinus and internal jugular vein. Less commonly the arterial blood finds its way into the superior cerebral veins and sagittal sinus, or by way of the basal vein of Rosenthal to the vein of Galen and the sinus rectus. Whichever route is taken the corresponding vascular channels become dilated and the walls thickened. These changes may be best demonstrated by angiography, which is an important

diagnostic adjunct in the diagnosis of these fistulas (Fig. 3). Occasionally it may demonstrate an unusual site of communication in the neck

"The local pathology of the carotid artery varies from practically a complete transection of the vessel to a minute opening barely visible (and at times not demonstrable at autopsy), but commonly it is a hiatus from 3 to 6 mm., which in traumatic cases may contain a spicule of bone. In some instances multiple openings are present. The position of the dehiscence in the carotid artery may be superior, mesial, or lateral. The position of the hiatus does not seem to influence the degree of exophthalmus nor to be related to a bilateral exophthalmus. Rather the bilaterality of the exophthalmus is dependent upon the size of the anterior and posterior intercavernous or circular sinuses. In many cases these communications are said to be too small to admit the point of a probe. With such stenotic connections between the two cavernous sinuses

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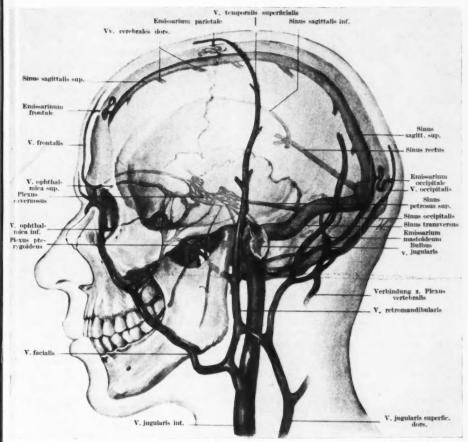


Fig. 2.—Venous communications of skull. Inferior petrosal sinus is not labelled. (Reproduced from Clara by kind permission of the author.)

a unilateral exophthalmus would be expected most commonly and is found in 80% to 90% of cases. In this series only two of the 24 patients had bilateral exophthalmus."

#### SYMPTOMATOLOGY

In 224 cases of pulsating exophthalmos collected by Martin and Mabon,<sup>6</sup> the incidence of symptoms and signs was, bruit 191; pulsation 179; chemosis 159; diplopia 76; headache 71; visual disturbances 66.

Bruit.—Bruit, or noise in the head usually is an early evidence of fistula; often it is present before exophthalmos develops. With the spontaneously developed fistula the patient may describe a loud "snap" in the head followed by a swishing or roaring

sound often referred to one or both ears. The onset with "snap" is rarely described in the instance of traumatic fistula. The bruit may be heard by the physician and not by the patient, according to Henderson and Schneider.7 Usually the bruit is heard best over the eye and temple. It is synchronous with the heart beat. Sometimes when it is heard bilaterally the louder sound usually indicates the side of the fistula. Bilateral fistulas are rare. Often the bruit can be abolished or diminished by pressure over the homolateral carotid artery in the neck. If at the time of injury the rent in the artery is filled with clot the bruit is not heard until the clot is dislodged.

Absence of bruit or failure to recognize

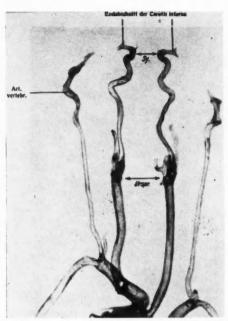


Fig. 3.—A radiographic study of dissected arteries showing plaque formation at sites of predilection. Note occurrence of plaque formation in the carotid syphon and at areas of branching. (Reproduced from dei Poli and Zucha. 35 (By kind permission of the publishers).

it when there is swelling of the eyelids, chemosis or exophthalmos has accounted for the diagnosis being missed. We have observed two such cases in which an erroneous diagnosis of retrobulbar hæmorrhage was maintained for several days in one instance, and for much longer in another.

Frequently recognition of a bruit by the physician, whether or not the patient is aware of it, establishes the diagnosis. However, a pronounced bruit may occasionally be heard over the eye when it does not signify the presence of carotid-cavernous fistula. In a woman who exhibited thyrotropic exophthalmos a loud bruit was heard when the stethoscope was placed on the left eye. Orbital decompression had been done on the right. It was noted that the bruit could be abolished by shifting the position of the stethoscope, and it could be lessened or eliminated by pressure on the carotid in the neck. The patient was not aware of any noise in her head. Obviously

the bruit originated in the orbit and was incited by a particular pressure of the stethoscope. A bruit may be heard as the result of an arteriovenous anomaly in the orbit not involving the cavernous sinus as in cirsoid aneurysms. These anomalies are developmental and not dependent upon trauma, although the patient shown in Fig. 4 did give a history of injury to the eye some years before the lid swelling ceveloped. In this case there was no bruit. It is stated frequently that hæmangioma of the orbit and also retrobulbar hæmatoma may be characterized by bruit. No doubt this is true but as yet we do not have records of such a case.

Pulsation.—Visible pulsation according to Martin and Mabon<sup>6</sup> was observed in 179 of 224 cases. It has been stated that pulsation is easier to feel than to see in some instances. In our experience it is easier to see pulsation in the dilated veins which may be present in the evelids than to recognize it in the eveball. Henderson and Schneider pointed out that the tonometer needle in these cases has a wide swing. In some instances pulsation of the globe can be recognized by blurring of the mires of the keratometer. Pulsations of the globe without bruit characterize defects in the orbital roof from whatever cause, such as neurofibromatosis and encephalocele.

Exophthalmos.—Usually this is unilateral and in the homolateral eve. It may become bilateral when the intercavernous sinuses become widely dilated, or if there is a bilateral fistula but this is extremely rare. Exophthalmos usually develops after the bruit has been recognized. It may develop with great rapidity or it may be delayed for as long as weeks. Usually the exophthalmos progresses and may become extreme; the cornea is then uncovered with disastrous results. Exophthalmos may disappear or be greatly reduced within hours after successful operative intervention. Meadows8 in discussing intracavernous aneurysm told of a patient in whom the aneurysm ruptured and a fistula resulted. After having manifested classical exorhthalmos there was spontaneous thrombosis, and ultimately there was enophthalmos of a blind eye (Fig. 5).

Contralateral signs in carotid-caverneus

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Fig. 4.—There was history of injury to the left eye without fracture; four years later the lower lid swelled. There was no bruit but some pulsation of vessels in the lids which could be abolished by pressure over the homolateral carotid artery. At operation it was shown that pressure over the external carotid materially reduced the pulsation and added pressure over the internal carotid completely abolished it. Both arteries were ligated. The pulsation was greatly decreased but cross circulation from the circle of Willis accounted for its persistence. Later, masses in both lids were excised and plastic surgery performed. Pathological studies showed blood vessels of all sizes, shapes and description. There were many large, chick-walled arteries, small arteries, very small capillaries, small venules and large veins. However, it presents a picture of an unusual hæmangioma. (From Clinical Neuro-Ophthalmology by Walsh, courtesy of the Williams & Wilkins Company.)

fistula.—Before considering other clinical features of these fistulas, mention is made of the infrequent occurrence of contralateral signs.

We have observed a patient in whom the bruit heard over both eyes was more pronounced over the left eye and was eliminated by pressure on the left carotid artery. The left eye was not proptosed but the right eye showed exophthalmos. Both sixth nerves were paretic, but trauma was not responsible. Ligation of the left carotid artery stopped the bruit and improved the situation generally. In such a case there must have been an abnormally wide communication between the cavernous sinuses,

and in all probability the superior ophthalmic vein on the side of the fistula was thrombosed. Dandy and Follis9 reported upon a patient who after a fall on the head developed proptosis of the right eye and bruit, and later developed proptosis of the left eye. At the time of examination both eyes were proptosed, there was bilateral sixth nerve paralysis and great widening of veins over the bridge of the nose and about the right orbit. The optic discs were pale, with visual acuity 20/50 in the right eye and 20/40 in the left eye. Pressure over the left carotid almost completely stopped the bruit whereas pressure over the right carotid failed to influence it. Partial occlusion of the left internal carotid artery and later complete occlusion of this vessel were performed. After each operation there was reduction in the size of the visible veins. The left carotid artery was clipped intracranially and the patient died ten hours later. Figs. 6 and 7 show the appearance of the patient and some features of the lesion as seen at the autopsy.



Fig. 5.—Long standing carotid-cavernous fistula producing extreme proptosis. Patient sought relief from repeated massive hæmorrhages from vessels in the skin of the right lower eyelid. He refused operation. (From Clinical Neuro-Ophthalmology by Walsh, courtesy of the Williams & Wilkins Company.)



Fig. 6.—Contralateral signs with carotid-cavernous fistula. (From Clinical Neuro-Ophthalmology by Walsh, courtesy of the Williams & Wilkins Company.)

Ramos and Mount<sup>10</sup> described a case in which the fistula involved the right carotid artery and the bruit was heard over the left eye. The left eye was proptosed 2 mm. with right eye vision 20/20 and left eye vision 20/70. Visual fields were normal. The veins in the left fundus were engorged, and there was weakness of the left external rectus muscle. The bruit was not eliminated by left, right or bilateral carotid compression. It was thought that the patient suffered from a carotid-cavernous fistula on the left, but a left carotid arteriogram failed to show the lesion. A right arteriogram showed the fistula on the right. It drained through the anterior intercavernous sinus into the left cavernous sinus and left superior ophthalmic vein. Because the bruit was not eliminated by bilateral carotid compression, a right vertebral arteriogram was made, and this showed a large right posterior communicating artery supplying part of the carotid circulation and explained why the bruit could not be eliminated by carotid compression.

Tamler<sup>11</sup> in reporting a case with contralateral signs suggested as possible explanations (1) small size of the fistula; (2) rapid development of thrombus on the

homolateral side; (3) obstruction of the communication between the superior ophthalmic vein and the cavernous sinus by pressure of the carotid artery; (4) traumatic rupture of the homolateral ophthalmic vein at the same time the rent is produced in the carotid artery; (5) a pre-existing vascular anomaly.

Not because it is characterized by contralateral signs, but because of its unusual nature an autopsied case with extensive damage to the floor of the orbit, sella turcica, optic canal and ethmoid sinuses is shown in Fig. 8.

Diplopia.—When trauma is responsible for the fistula, cranial nerve palsies may result from direct trauma to the nerves. Sixth nerve paresis is most common, but all the cranial nerves which pass through the cavernous sinus may be affected, and thus total ophthalmoplegia may develop. Possibly the immediate relationship of the sixth nerve and the inferior petrosal sinus may contribute to the frequency of sixth nerve involvement in these cases. The sensory fifth nerve, usually the ophthalmic division, may be affected. However, as with intracavernous aneurysm of the carotid artery, corneal sensation may remain when

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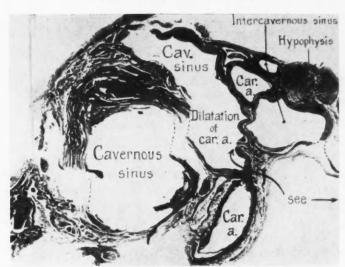


Fig. 7.—Autopsy findings of patient shown in Fig. 6 reveal an opening in the dilated left carotid artery with displacement of the hypophysis to the right and complete erosion of the wall of the left ethmoid sinus. The left superior ophthalmic vein was almost entirely occluded. Although widely dilated, the right cavernous sinus was only a third the size of the left one. Considerable dilatation of the right superior ophthalmic vein and of orbital veins on both sides was also found. The petrosal sinuses were very small, the inferior petrosal sinuses ending in blind pouches—hence the anterior dilatation of veins. The hypophysis pressed on the right third nerve. The dilated sinus pushed the carotid artery against the optic nerve. The ophthalmological lesion was diagnosed as optic atrophy with mild retinal arteriosclerosis. (From Clinical Neuro-Ophthalmology by Walsh, courtesy of the Williams & Wilkins Company.)

there is pronounced ophthalmoplegia. In some instances only the supraorbital fifth nerve is affected, and this presumably is from pressure of the dilated superior ophthalmic vein. There does not seem to be a definite relationship between the severity of the ophthalmoplegia and the amount of exophthalmos. Pressure palsies appear later than palsies due to direct injury which develop immediately. Recovery from diplopia has followed therapy in some of our cases. In one instance only, aberrant regeneration of the third nerve was observed. The case summarized below is of interest as regards ophthalmoplegia, pupillary state and contralateral signs (congestion of the contralateral eye).

A 60 year old white woman suffered rupture of an intracavernous carotid aneurysm on the right side. After severe pain in the head for several days she developed a total right-sided ophthalmoplegia with retention of corneal sensitivity. The right eye was not proptosed.

The patient was aware of a noise in the head, and a bruit was heard over the right eye and temple. The right eye remained white. Three weeks later the left eye became extremely congested and still the right eye was neither congested nor exophthalmic. The right carotid was clipped intracranially and the internal carotid was ligated in the neck. Visual acuity was 20/40 and 20/20 in the right and left eyes respectively two years later. The only remaining evidence of the ophthalmoplegia was slight limitation of upward and downward movement of the right eye. On the right she originally had a moderately dilated pupil (presumably the sympathetic had been interrupted, hence lack of complete widening of the pupil) but ultimately the right pupil was of the pseudo Argyll Robertson variety, undoubtedly a manifestation of the regeneration syndrome.

Headache.—With cases which develop spontaneously the onset often is sudden. There is a snap or crash felt in the head accompanied by sudden severe head pain. Such an onset does not characterize trau-

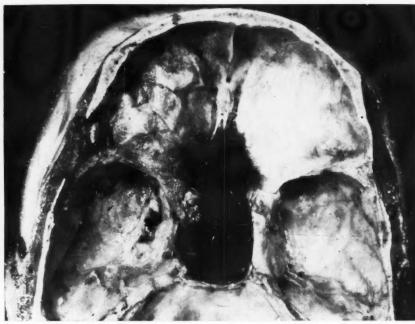


Fig. 8.—A 45 year old man struck by a car was unconscious for several days. Scalp was lacerated. The left eye was blind and right eye vision was defective after the accident. There was progressive exophthalmos on the left and the patient complained of noise in the head. He died 14 weeks later as a result of massive hæmorrhage from the nose and mouth, Operation had been posted for the next day. Autopsy revealed fracture of the left orbital roof; laceration of the left carotid artery under the dura and extending into the cavernous sinus; erosion of bone at the base involving the floor of the orbit which was paper thin, the sella turcica, the optic canal and ethmoid sinuses. The hæmatoma communicated with the nasal cavity. (Courtesy of Dr. Lindenberg.)

matic cases. Except at the onset pain has not been a prominent feature in our cases but, as would be anticipated, discomfort in the proptosed eye is described frequently. In one patient whose fistula may have been traumatic the discomfort in the affected eye was increased when she was lying down. The situation was similar to that which we have seen in two patients who exhibited intermittent exophthalmos; they had exophthalmos when lying down and enophthalmos when they stood or sat up.

Visual disturbances, optic fundi, ocular tension.—In a minority of cases the optic fundi remain quite normal and there is no complaint of visual defect. According to de Schweinitz,<sup>3</sup> 20% of all patients with this involvement lose all useful vision in the affected eye. Certainly in the majority of cases visual results are poor if therapy

is unsuccessful. In untreated cases there is usually venous engorgement and some degree of irregular arterial narrowing with retinal œdema. Papillædema is uncommon according to our experience. The vitreous becomes cloudy, and there is late development of cataract in some cases. Thrombosis of the central vein occurs infrequently. We have however observed it in a patient whose fistula was cured spontaneously apparently as a result of pressure over the carotid. Retinal hæmorrhages are not uncommon. In cases of long-standing, optic atrophy may be present, and in some traumatic cases optic atrophy occurs early, seemingly as a result of direct injury to the optic nerve. It has been suggested that when the optic fundus remains normal the central retinal vein empties into the inferior ophthalmic vein, and thus congestion of the retinal veins may be avoided. Ellio 12

has remarked upon visual failure being due to embarrassment of both arteries and veins in the affected eye. Optic atrophy as already pointed out may be due to direct trauma. It may result from pressure from the cavernous sinus as recorded by Dandy and Follis. Presumably it may follow defective blood supply. Transient loss of vision from manual pressure on the carotid characterized Elliot's second case. Some degree of glaucoma is present in many cases and is probably properly attributed to increased ep scleral venous pressure. In this regard a contribution by Swan and Raaf13 and an ther by Hollenhorst14 are of importance. Swan and Raaf found in patients subjected to ligation of the common and external carotid arteries as treatment for fistula that there was lowering of the ocular tension of the homolateral eye, diminution in pulsation and volume in the retinal arteries, and a retinopathy characterized by macular ædema and multiple cotton wool exudates at the posterior pole. In their cases some elevation of ocular tension was present in most instances before the ligation. Hollenhorst found intermittent homolateral visual loss to be a significant symptom in regard to the later development of full-blown thrombosis of the carotid artery. In such patients who suffered periods of loss of vision the homolateral fundus in some instances appeared similar to that described by Swan and Raaf.

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It is generally agreed that early operation is advisable because when it is delayed the affection often progresses to a stage where even the most drastic procedures are futile. No procedure yet devised can be guaranteed to give permanent relief invariably, even when performed at the most opportune time. Many procedures have been utilized with some success, namely intermittent pressure on the carotid in the neck, extirpation of orbital veins, ligation of the common, internal and external carotid arteries on the homolateral side alone, or as combined procedures, packing the sinus with muscle, combined ligation of the carotid in the neck and in front of the cavernous sinus with in some instances ligation of the ophthalmic artery. At this time in the Johns Hopkins Hospital there is no single surgical procedure which is invariably utilized. Certainly in some instances ligation of the common or of the internal carotid artery has sufficed. It is not agreed which of these procedures is the better. Now there is a distinct tendency towards (1) early arteriography and (2) a combined procedure of ligating the carotid artery both intracranially and in the neck—the trapping procedure—and to this there may be added ligation of the ophthalmic artery. To 15-17

It is of considerable interest that the first ligation of the common carotid artery was performed in 1805 by Astley Cooper<sup>18</sup> for carotid aneurysm in the neck, at a time when anæsthesia was not available. Shortly thereafter Travers<sup>19</sup> performed a similar operation for pulsating exophthalmos. A footnote to his paper is intriguing, when one remembers that it was written before the advent of the ophthalmoscope—"In the misty vision preceding blindness from idiopathic affections of the retina, objects appear for the most part smaller than natural".

### ASEPTIC THROMBOSIS OF THE CAVERNOUS SINUS

This is an infrequent occurrence. Many years ago MacEwen pointed out that septic thrombosis characteristically involves the paired sinuses whereas non-septic thrombosis affects unpaired sinuses. I have encountered a patient who showed the effects of aseptic cavernous sinus thrombosis, and trauma was apparently responsible.

A 66 year old man fell to the floor and became unconscious for a short time. There was bleeding from the left ear and subsequently there was loss of hearing on that side. Six days after the fall he had a total right ophthalmoplegia and proptosis. A right-sided subdural hæmatoma was evacuated. He remained in hospital for five weeks and during the early part of his stay left-sided sixth and third nerve palsies developed but these cleared. When he was discharged at the end of five weeks the proptosis on the right had almost completely disappeared, but the ophthalmoplegia persisted on that side. A right carotid

<sup>°</sup>I am indebted to the courtesy of Dr. Maurice Silver for presenting this case.

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arteriogram was read as normal. My examinations made several weeks after his discharge from hospital showed a complete right ophthalmoplegia with ptosis, loss of corneal sensation and also a pupil semidilated and fixed to light. The left eye was normal, R.E.V. 20/200; L.E.V.20/20. There were a few hæmorrhages in the right fundus; the left fundus was normal. Exophthalmometer reading showed: R.E. 20 mm. and L.E. 19 mm. The diagnosis was traumatic subdural hæmatoma associated with thrombosis of right cavernous sinus with extension to the left. Two years later the ophthalmoplegia on the right had cleared in part, but there was aberrant regeneration of the right third nerve.



Fig. 9.—Hæmorrhages in optic nerve sheaths and within eye, (Hedges and Walsh.)

#### Angiography, Ocular Complications

Arteriography has become almost a routine procedure when intracranial tumour, aneurysm or vascular anomaly is suspected. That such an examination occasionally gives rise to unfortunate complications is generally well known. It is recognized however, to have great value. Mention is made here of ocular complications. In some instances these are transitory.

When injecting the carotid artery pain in the eye assures the operator that the needle is in proper position and the contrast media is entering the artery. Transitory widening of the pupil may develop to be followed by narrowing. There is said to be transitory narrowing of the retinal arteries, then widening. In some instances petechial hæmorrhages develop in the conjunctiva and in the skin of the face about the homolateral eye. Retinal hæmorrhages



Fig. 10.—A 51 year old man suffered from headaches and hypertension. For two months he had complained of blurred vision, and then two months later of severe headaches. He lost consciousness suddenly and died. There was rupture of a vertebral aneurysm. Illustration shows hæmorrhage within the optic nerve sheaths, in this instance associated with subarachnoid bleeding. There was no history of trauma.

and cotton wool exudates have been observed. There may be temporary unilateral or bilateral loss of vision from carotid and from vertebral arteriography. Jamieson<sup>20</sup> reported rupture of an intracranial aneurysm during arteriography.

Hæmorrhages may develop within the optic nerve sheaths when there is subarachnoid hæmorrhage from any cause, ruptured aneurysm, vascular hypertension or injury. Hedges and Walsh<sup>21</sup> described what must be considered an unusual traumatic case of optic nerve sheath hæmorrhages seemingly incited by angiocardiography. Optic nerve sheath hæmorrhages in themselves are not responsible for loss of vision.

The patient was a 36 year old woman who had congenital heart disease with cyanosis from birth. There were multiple cardiac defects and polycythæmia. Intra-arterial angiocardiography was attempted. A catheter was passed from the left brachial artery to the region of the aortic arch, and 22 c.c. of iodopyracet was injected. Convulsions developed immediately and death took place three hours later. Autopsy revealed absence of hæmorrhage over the convexity and at the base. There was a cerebellar pressure cone present, and there were petechial

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hæmorrhages in the occipital cortex, thalmus, cerebellum and pons. There were profuse optic nerve sheath and intraocular hæmorrhages.

It would seem that in this case isolated hamorrhages in the optic nerve sheaths and intraocular hamorrhages originated as a result of intracranial venous stasis associated with a rapid rise in intracranial pressure. The reason for the swelling of the brain could not be considered as clearly established (Figs. 9 and 10).

Other complications of carotid arteriography are, thrombus formation at the site of artery puncture, local aneurysm formation and carotid-jugular fistula. Fleming and Park<sup>22</sup> described dissecting aneurysm of the carotid as a result of arteriography. In one of their patients the artery was sufficiently narrowed for a massive cerebral infarction to result. In their other patient the hæmorrhage in the wall of the artery was small and was only an incidental finding. They pointed to the possible intimal elevation inciting thrombus formation and becoming a potential source of emboli. Although large dissecting aneurysms rarely occur as a result of arteriography, they, together with other local changes in the artery, may explain certain postangiographic phenomena and incomplete filling of the affected carotid artery.

Mention is made here of a patient whom I have not seen but whose history I know and whose roentgenograms I have examined. She had suffered a stroke and three months later bilateral carotid arteriograms were made, the procedure being carried out under general anæsthesia. Visual acuity said to have been normal previously was nil when she awakened. Several months later she was said to have questionable light perception, with the optic fundi normal in appearance. It is probably advisable to avoid bilateral filling of the carotids in patients who have had cerebrovascular accident.

UNUSUAL CAROTID ARTERY TRAUMAS
Recently we have observed three patients
in whom surgical procedures resulted in
what are properly termed carotid complications.

Case 1.—Homolateral blindness after carotid endarterectomy was encountered in

a 53 year old man suffering from vascular hypertension after he had been subjected to nephrectomy for an abnormally small right kidney and narrowing of the right renal artery.

Several days after operation he developed left-sided signs and arteriography showed a plaque in the right carotid artery. At end-arterectomy a large plaque was removed from the artery. He suffered loss of vision in the right eye and developed obstruction of the central retinal artery. It seemed probable that an embolus from the plaque or from a thrombus was responsible but it remains a possibility that retinal arterial spasm may have been the important factor. The eye remained blind and developed pronounced atrophy of the optic nerve.

Case 2.—Severe hæmorrhage took place at termination of operation for removal of chromophobe adenoma. Probable source was the left carotid. Local pressure controlled bleeding; however a transient total loss of vision ensued, followed by pronounced recovery.

A 63 year old man suffered loss of vision in the left eye over a period of five to eight weeks. Fields showed bitemporal defects, more extensive on the left. R.E.V. was 20/15, with L.E.V. 20/100. Roentgenograms revealed erosion of sella, minimal calcification in suprasellar region. A right-sided carotid arteriogram showed a minimal elevation of the right anterior cerebral artery, but no evidence of aneurysm.

Operation went well; the adenoma presented between the two optic nerves exerting pressure particularly on the left nerve. Intracapsular removal was performed with a small portion of the capsule removed. Pituitary rongeur damaged a vessel and profuse arterial hæmorrhage occurred. Pressure on the left carotid in the neck reduced the bleeding considerably, but pressure inside the tumour capsule and use of Gelfoam after an hour controlled the hæmorrhage. The carotid in the neck was never compressed for more than five minutes. Optic nerves seemed not to be grossly damaged. For four days the patient was completely blind, then vision returned in the right eye. Twenty days after operation R.E.V. was 20/50 and no light perception could be found in the left eye. Radiotherapy was given to the pituitary region. The patient was discharged three weeks after operation on 12.5 mg. of cortisone

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Fig. 11.—The patient was a 42 year old man who had been drinking excessively. A few minutes after leaving his home he was found lying on the ground. In getting into an automobile he had struck his head. Later that night he was found dead. Note the severe deformity of the brain caused by the extradural hæmatoma. There was absence of contusions of the brain. The ventricles were displaced to the right, with a herniated and bulging uncus. Left optic tract was distorted. (Courtesy of Dr. Lindenberg.)

twice a day, and one grain of desiccated thyroid extract daily. Two months after operation right eye vision had returned to normal, and hand movements could be perceived by the left eye. The field defects of the left eye persisted and a minimal temporal defect remained in the

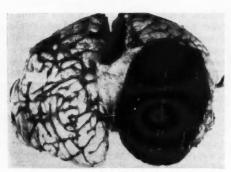


Fig. 12a.

right field. Both discs were pale. Chromophobe adenoma of the pituitary was diagnosed histologically.

Case 3.—Total ophthalmoplegia resulted from wounding carotid artery during operation for tic douloureux. Pain was relieved and the patient recovered from ophthalmoplegia.

An elderly woman suffered from classical tic douloureux. She had been treated effectively with stilbamidine, first orally and then intravenously. However, after two years of relief, pain returned and she could not tolerate stilbamidine any more. It was decided that because of involvement of the second and third division of the right fifth nerve, retrogasserian neurectomy via a temporal approach was in order. The operation was done with the patient in sitting position, and the right gasserian ganglion was exposed without too much difficulty. There was moderate adherence of the dura to the base of the skull. Just before the end of the procedure when the dura propria of the ganglion was incised there was sudden profuse arterial bleeding. The operator was not sure whether an unusually tortuous carotid artery or an atypical large vessel had been wounded. The right carotid artery was exposed in the neck and partly occluded; bleeding



Fig. 12b.

Figs. 12a and 12b.—A 45 year old woman fell four feet from a ladder and struck her head in falling. She was lucid on admission to hospital although bleeding from the right ear. Spinal fluid was bloody. Blood pressure was elevated and the pulse became slowed. The left pupil was dilated and fixed. She became comatose and developed left hemiparesis. Roentgenograms revealed a fracture of the skull. Operation showed only contusions of the right hemisphere. She died three hours after operation. There was an extradural hæmatoma over the right occipital pole at the site of the coup and a contrecoup hæmorrhage over the left frontal lobe, with subdural and subarachnoid hæmorrhage. No significant herniation of the right uncus was seen. Note the deformity of the brain stem. Operation failed to reveal the site of the extradural hæmatoma because only that portion anterior to the hæmatoma was inspected.

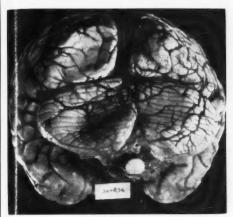


Fig. 13b.

Fig. 13a.

Figs. 13a and 13b.—A 32 year old man involved in a fist fight became drowsy after a few hours. Bilateral trephine holes were made but nothing was found. He died two days later; his skull was fractured. Autopsy revealed severe deformity of the cerebellar and occipital lobes as a result of a large collection of blood in this area. Fourth ventricle was compressed. The particular feature of interest is the deformity of the chiasm from pressure within the third ventricle from early hydrocephalus.

was controlled by applying pieces of muscle and using Gelfoam locally. Although the patient's condition was critical for two days there was no neurological deficit on the left side of the body. However there was a total right-sided ophthalmoplegia sparing the pupil which reacted to light and was only slightly larger than its fellow of the opposite side. The operation resulted in decompression of the gasserian ganglion and possibly temporary relief from pain. Within two months the ptosis diminished and at the end of three months ophthalmoplegia had improved remarkably.

Cases 2 and 3 are of particular interest in that as a result of wounding presumably the carotid artery, there was in one instance, Case 2, pronounced loss of vision with recovery, and in Case 3 there was pronounced ophthalmoplegia with almost complete sparing of the pupil, and again recovery. In the patient with chromophobe adenoma, Case 2, it would seem that pressure was made on the chiasm or optic nerves, whereas the patient suffering from tic douloureux developed ophthalmoplegia as a result of pressure on the right cavernous sinus region.

EXTRADURAL AND SUBDURAL HÆMATOMAS
The symptomatology in these conditions
is sufficiently similar for them to be con-

sidered together. Types of hæmatomas are defined briefly as an introduction.

Extradural hæmorrhage (hæmatoma) almost invariably, is the result of traumatic rupture of a branch of the middle meningeal artery or vein. It occurs in approximately 3% of all cases of acute head injury described by Woodhall, Devine and Hart.<sup>23</sup> Such a hæmorrhage may be located rarely in the anterior or the posterior fossa.

Subdural hæmatoma is either acute or chronic. The acute variety constitutes a surgical emergency and in consequence is not as familiar to ophthalmologists as chronic subdural hæmatoma. The acute type is associated with bleeding at other sites, extradural, subarachnoid or intracerebral and with brain damage. It always results from trauma.

Chronic subdural hæmatoma is usually situated over one or both cerebral hemispheres, and when fully developed consists of an encapsulated collection of blood. The hæmatoma usually extends from the frontal to the occipital region and from the falx to the sylvian fissure. Unusual positions are over the temporal lobe; between the cerebral hemispheres; between the temporal and occipital lobes; over the cerebellum, 31 or within the sella turcica. 24, 25 Trauma is almost always the etiological

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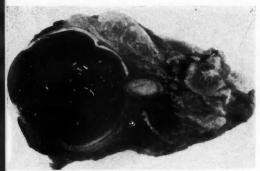


Fig. 14.—Extradural hæmatoma as a result of self inflicted bullet wound was associated with massive intraocular hæmorrhage when the orbit and eye were not directly traumatized. (Courtesy of Dr. Lindenberg.)

factor. Predisposing factors are blood diseases, alcoholism, syphilis, cortical atrophy, and, particularly in children, vitamin deficiency including scurvy.

# EXTRADURAL (EPIDURAL) HÆMORRHAGE

Pathology.—The middle meningeal artery after entering the skull through the foramen spinosum divides into anterior and posterior branches. It is commonly stated that the anterior branch is torn most frequently as it crosses the inferiomedian angle of the sphenoid bone. Wood-Jones<sup>32</sup> showed that in actuality the bleeding is often venous in origin, and in his opinion injury to the bone in this region is more likely to injure the vein than the artery. He noted that slight trauma is usually responsible for the syndrome particularly in children. The injury often accounts for fracture of the parietal and temporal bones. The dura is separated from the skull by the hæmorrhage and as separation proceeds, other small vessels are ruptured and the bleeding is increased (Figs. 11, 12a and 12b). When there is no fracture such hæmorrhage occurs very rarely and probably only in elastic skulls. The bone indents and the dura stretches. The posterior branch of the artery is damaged relatively seldom (Figs. 13a and 13b). Extradural hæmorrhage through extension to the base may produce pressure on the cavernous sinus.

Symptomatology.—Injury to the head may produce in sequence (1) loss of conscious-

ness from which there may be recovery, (2) a latent period which may be prolonged,31 after return to consciousness or without unconsciousness when it would seem that the injury has done no harm, (3) evidences of increasing intracranial pressure, (4) coma and death if relief has not been available. Death often occurs within four hours. Evidences of increasing intracranial pressure are severe headache, vomiting and drowsiness. There may be focal convulsions usually on the side opposite the lesion, commencing in the face and extending to the arm and leg. The convulsions may be followed by hemiplegia. Occasionally the hemiplegia is ipsilateral when the cerebral peduncle is pushed against the tentorium of the opposite side. Temperature may be elevated, blood pressure increased and the pulse irregular and often slow.

Ocular signs are similar to those observed in some cases of chronic subdural hæmatoma and subsequently they are discussed in more detail. Pupillary widening with slow or absent response to light, or transient widening is important because in the majority of instances such pupillary change is on the side of the lesion although occasionally the dilated pupil is contralateral to the lesion. Paresis of all the extraocular muscles occurs but it is uncommon for a total ophthalmoplegia to be seen or for the third nerve to be completely paralyzed. In some instances of course the ophthalmoplegia results from direct injury to the nerves and then the paralysis is likely to be immediate and total. Congestion of the eye homolateral to the lesion is seen frequently; it may result from pressure on the cavernous sinus. Usually both optic fundi remain normal in appearance. If there is intraocular hæmorrhage the probability is that there is associated subarachnoid hæmorrhage, although an exception is illustrated in Fig. 14.

# Acute Subdural Hæmatoma

The signs are dependent upon the nature of the injury and in consequence they do not follow any definite pattern as in chronic subdural hæmatoma. Here particular mention is made of a case selected because of its historical interest. The patient was President

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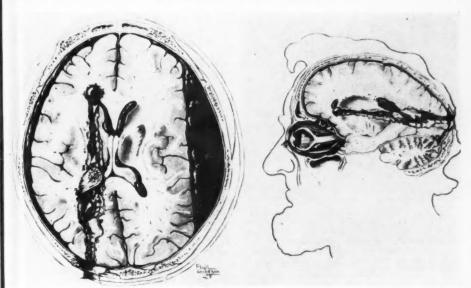


Fig. 15.—The assassin, John Wilkes Booth, using a Derringer pistol, fired at the President's head from a distance of a few feet. The heavy bullet perforated the skull in the left occipital region, penetrated the dura and having torn the left lateral sinus passed through the cerebrum to lodge in the white matter above the anterior portion of the left corpus striatum. Both orbital plates were fractured but the bullet had not touched any bony structure anteriorly. Either contrecoup or blast effect was responsible. Both orbits were filled with blood. (Courtesy of Colonel George Hayes.)

dent Abraham Lincoln. Details regarding his fatal injury are to be found in a volume entitled Medical and Surgical History of the War of the Rebellion, published in 1875, and edited by J. K. Barnes, Surgeon-General of the United States. Colonel George Hayes has prepared an illustration depicting the injury (Fig. 15); it has particular interest in exemplifying bilateral exophthalmos associated with a gunshot wound when the bullet did not injure the orbits directly.

With acute subdural hæmatoma or other space-consuming lesions (epidural and chronic subdural hæmatomas, tumour or abscess) above the tentorium, the cerebrum partly escapes by shifting towards the opening in the tentorium. This leads to compression of the midbrain with narrowing of the interpeduncular fossa, and depending on the width of the tentorium to herniation of the ipsilateral hippocampal gyrus or a portion of it into the subtentorial space. Herniation and pressure on the midbrain are shown in Figs. 17 and 18. If the uncus (anterior portion of the hippo-

campus) herniates, the third nerve is stretched and squeezed against the clivus.

Occasionally a hæmatoma is found on the same side as the hemiplegia. This is the crus syndrome (Kernohan). Examples of the mechanism accounting for this syndrome are shown in Figs. 19 and 20.

Oculomotor and midbrain involvement is least likely to occur if the midbrain is displaced forward, as in hæmorrhage over the occipital lobe, shown in Figs. 12a and 12b. When there is evidence of intracranial bleeding in the absence of pupillary signs, the hæmorrhage may be located posteriorly.

#### Chronic Subdural Hæmatoma

Occurrence.—Such hæmatomas are frequent in children from early infancy to two years of age, and in adults from 20 years to late adult life (Fig. 21). Why there is a hiatus in age is not known. Govan and Walsh<sup>26</sup> suggested that in infancy vessels which cross the subdural and subarachnoid spaces are not supported by pacchionian granulations which develop in early childhood.

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Fig. 16.—Normal section through midbrain showing third nerves, their relation to the tentorium and to the clivus, to the cavernous sinus region on each side, to the posterior communicating and posterior cerebral artery on the left (right posterior cerebral artery removed). Note normal width of interpeduncular fossa.

Latency.—This period during which there may be no symptoms varies within wide limits. Kunkel and Dandy<sup>27</sup> found it to average three weeks. Certainly after months have passed the possibility of subdural hæmatoma is greatly lessened. In children trouble from subdural hæmatoma of long-standing is occasionally encountered.



Fig. 17.—Illustration of hemiation of the right hippocampus due to massive extracerebral hæmatoma. Such hemiation occurs with extradural or subdural hæmorrhage. Note hæmorrhage at tip of right third nerve, and the furrow caused by pressure of the tentorial edge, compared with normal appearance shown in Fig. 16. (Courtesy of Dr. Lindenberg.)



Fig. 18.—Severe pressure on the midbrain from paramedial hæmorrhage involving the region of the third nerve nuclei. The superior colliculi are hæmorrhagic and necrosed from compression of the long circumflex vessels over the dorsum of the midbrain. Hæmorrhage extends from the compressed interpeduncular fossa region to the nuclei of the third nerves, Had the patient recovered he would have shown paralysis of the third and fourth cranial nerves, Parinaud's syndrome and even temporary involvement of long tracts.

Symptoms and Signs.—In infants convulsions and progressive enlargement of the head are principal evidences of subdural hæmatoma (Fig. 22). The fontanel bulges, and vomiting and irritability are noted in half the cases. Tapping the subdural space through the fontanel establishes the diagnosis in most instances. The spinal fluid contains blood or is xanthochromic in children but not in adults.

Bilateral lesions are much more numerous in infants than in adults.

In adults headache, drowsiness, mental confusion and irritability are characteristic. Nausea and vomiting, vertigo, tinnitus, diplopia, convulsions, hemiparesis, loss of vision and hearing as well as sensory changes occur in various instances. However, there are often few evidences and in approximately half of the cases studied a cerebral tumour was suspected. Diagnosis is established by arteriography, air injection or at operation. Increased intracran al pressure is responsible for much of the symptomatology but is not always present.

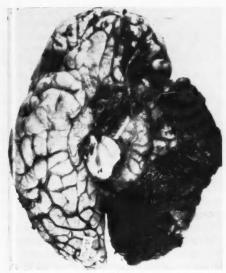


Fig. 19.—A 78 year old man was found unconscious lying on the floor. He had no history of hypertension but had suffered a blow on the forehead and was apparently well the day before the accident. Autopsy revealed subdural hæmatoma of the lower left temporal lobe, and a small contusion of the uncus. The entire left hippocampal gyrus was herniated. The midbrain was shifted towards the contralateral rim of the tentorium; long tracts in the peduncle were lacerated. Since the tracts had not yet crossed the resultant hemiplegia was ipsilateral to the hæmorrhage. Paramedial hæmorrhage is again apparent.

When a subdural hæmatoma produces symptoms and signs the patient usually dies unless he is treated (Fig. 23). However it is noteworthy that autopsies frequently reveal evidence of long-standing chronic subdural hæmatoma in patients who have had no symptoms or signs of intracranial damage (Fig. 24).

A patient of Dr. McQueen's exemplified the paucity of signs which may characterize cases of chronic subdural hæmatoma.

I have had under my care a very elderly lady who had been subjected to bilateral cataract extraction. The operations were performed without incident by a colleague. As time passed she became somewhat careless after having been fastidious about herself, and she did not seem always to be in good contact. There were no physical signs, but her change in personality after several months had passed was such that a colleague suggested burr holes be made. Bilateral chronic subdural hæmatomas were

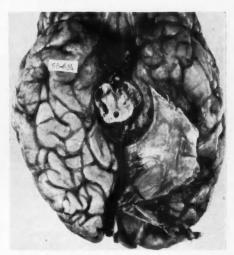


Fig. 20.—Residual of midbrain pressure necrosis and hæmorrhage from left-sided subdural hæmatoma. The patient who had been vegetating, showed contractures and decerebrate rigidity.

discovered. She soon regained her former status and then a history of trauma while getting into a car was elicited.

# Ocular Signs

Pupillary changes.-Dilatation of the pupil homolateral to the side of the hæmatoma is an important sign, and such widening of the pupil is significant even though it may be transitory. Occasionally the pupil contralateral to the lesion is widened and reacts poorly or not at all to light, Pupillary widening is the result of third nerve involvement because in many instances it is followed by other evidence of third nerve palsy. We have never observed a total paralysis of the third nerve with chronic subdural hæmatoma, but such total involvement has been seen with acute subdural hæmatoma.28 How is the third nerve involved? The following explanations seem valid. (1) Herniation of the hippocampal gyrus produces pressure on the nerve at the edge of the clivus, or where the nerve passes between the superior cerebellar and posterior cerebral arteries; (2) distortion of the midbrain may produce pressure on one or other third nerve; (3) hæmorrhage into the midbrain may affect the nerve or nucleus (in this instance it would seem unlikely that only the pupil would be affected).

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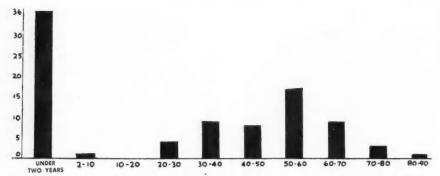


Fig. 21.—Age incidence of subdural hæmatoma in a series of infants and children. (From Govan and Walsh by courtesy of the Archives of Ophthalmology, published by A.M.A.)

Through the courtesy of Dr. John P. Gallagher we have had access to a survey of cases of epidural hæmorrhage which Dr. Jefferson Browder and he have observed. Their study has not yet been published. There were 167 cases of extradural hæmorrhage with homolateral enlargement of the pupil in 94 instances, and contralateral enlargement in 10, while in 63 patients the pupils had remained of equal size. Their observations concerning the 63

patients with pupils constantly of equal size are interesting. In 24 of these subjects the clinical course was slow, in most instances extending over several days. Seemingly the oculomotor nerve was thus able to withstand the gradual increasing pressure. In 11 patients the course was such that one would have expected one pupil to show enlargement but it did not. In 18 cases both pupils were widely dilated; these patients were in a terminal state. Observations of five patients were unsatisfactory, since one had been given atropine, another morphine, and in three others the clots were bilateral.

If the third perve is involved peripherally

If the third nerve is involved peripherally in the majority of these cases, and the evidence points to this, an explanation for the selective involvement of pupillomotor fibres is necessary. From the work of Sutherland and his collaborators it seems that the third nerve in the region where it is pressed upon carries pupillomotor fibres in such a position that they are first subjected to pressure. When the pupil is dilated contralateral to the lesion the distortion of the brain stem probably accounts for the contralateral pressure.

With infants pupillary dilatation is not as important a localizing sign as it is in adults because in them subdural hæmatomas are so often bilateral. In infants we have seen bilateral pupillary narrowing. The mechanics of such narrowing is not understood. It is not as ominous as bilaterally dilated and fixed pupils.

A particular feature of pupillary widening with subdural hæmatoma is the almost immediate return of the pupil to normalcy

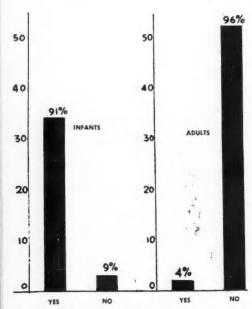


Fig. 22.—Incidence of history of convulsions in infants and in adults with subdural hæmatoma. (From Govan and Walsh, by courtesy of the Archives of Ophthalmology, published by A.M.A.)

when the subdural clot has been evacuated.

Conjugate deviation of the eyes.—Govan and Walsh observed conjugate deviation of the eyes away from the side of the lesion in two adults suffering from subdural hæmatoma. It was thought that deviation was due to a hemispheric lesion on the side opposite that of the hæmatoma; the deviation disappeared after evacuation of the clot. In this regard the hemisphere not involved by the hæmatoma is often severely flattened and circulatory disorders due to pressure may depress its frontal area for conjugate ocular movements. In infants conjugate deviations are seen commonly as part of a convulsion so that, also considering the probability of bilaterality, the observation is of little significance. Nystagmus which we have seen infrequently, may be the result of weakness of conjugate movement.

Exophthalmos. - Pfeiffer's paper<sup>29</sup> concerning exophthalmos in juveniles with subdural hæmatomas is important. We not recognized such cases. have particularly significant that occur during the age span when subdural hæmatomas are rarely seen (Fig. 21). In such cases there is a characteristic group of changes seen in roentgenograms. There is widening of the middle cranial fossa with, in some instances bulging of the temporal fossa, elevation of the wing of the sphenoid, widening of the superior orbital fissure, and indentation of the lateral wall of the orbit which may produce exophthalmos. In addition there may be cranial nerve palsies, papillædema and other evidences of increased intracranial pressure. It is my belief that an identical picture to that which Pfeiffer has described may be associated with arachnoid cysts. That however is not under consideration at this time.

Papillædema. — Papillædema has been estimated by Dandy to affect approximately 50% of cases, but Govan and Walsh found it in 17% of 91 cases (37 infants and 54 adults). Huber³³ found papillædema somewhat more frequently than Govan and Walsh. The papillædema observed in adults is similar to that resulting from intracranial tumour, and in the majority it is of low-grade severity. In adults when hæmor-



Fig. 23,—Classical large chronic subdural hæmatoma with connective tissue capsule located at the usual site. There was an old contusion focus indicating trauma as the etiology.

rhages are present they are of the nervefibre layer variety. Papillædema tends to be more severe in infants than in adults, and is often associated with subhyaloid hæmorrhages. This may be due to a greater tendency to swelling of the infant brain which contributes to the already existing increased intracranial pressure. Probably papillædema usually develops late. The difference between the intraocular hæmorrhages in infants and in adults suggests that in adults the intracranial pressure builds up more gradually than in infants. We have seen massive intraocular hæmor-

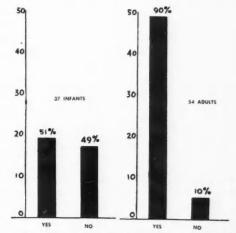


Fig. 24.—Incidence of history of trauma in 37 infants and in 54 adults with subdural hæmatoma. (From Govan and Walsh, by courtesy of the Archives of Ophthalmology, published by A.M.A.)

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Fig. 25.—In this combined air and arteriogram study, note displacement of the ventricles and of the arteries (upper right). The patient was a 34 year old Negro, who was out of contact and the history was obtained from his wife. She described symptoms of paranoid behaviour for at least five years. These became more pronounced in the month before admission. He became increasingly drowsy during this time and complained of bifrontal pain. Although there was no definite history of head injury, his mode of living made such trauma not unlikely. He was lethargic and disorientated, with pulse rate below 50, and no localizing findings. After evacuation of the subdural hæmatoma he made an excellent recovery.

rhage in an eight month old child. Gardner's studies showed that increased intracranial pressure is by no means constantly present in patients with subdural hæmatoma.

Visual Field Defects.—Homonymous hemianopic field defects are recognized in a minority of cases. Huber observed quadrantanopic field defects. Such defects are probably missed often because of the inability of the patient to co-operate. Maltby<sup>30</sup> found such defects in 11% of 62 cases (five contralateral, one ipsilateral, one left-sided when the dural clot was centrally situated). We observed an interesting set of findings in the patient whose case is summarized below.

A 46 year old woman was brought to the accident room in semicomatose state. Subdural hæmatoma was suspected. A clot and membrane were removed from over the right hemisphere. She regained consciousness after operation.

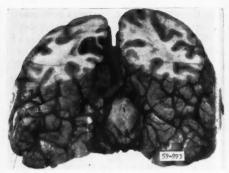


Fig. 26.—The calcarine area on the right shows early hæmorrhagic necrosis. This has resulted from compression of a branch of the right posterior cerebral artery through herniation of the right hippocampal gyrus and pressure of the tentorial edge.

There was right hemiparesis with sensory changes in the right arm and leg, and total left homonymous hemianopsia. Vision could not be assessed adequately. There was right upper motor neuron facial paralysis, incomplete right ophthalmoplegia with a fixed dilated right pupil. The left pupil was dilated and fixed to light. The left eye moved to the right normally, but it could not be moved to the left on command, although it did so while fixing a light. There was inability to look up with either eye, although Bell's phenomenon was present in some degree on the left. Papilledema was present on the right; the left fundus was normal.

There was herniation of the right temporal lobe with pressure on the right third nerve; left homonymous hemianopsia from obstruction to the branches of the right posterior cerebral artery by the tentorial edge; hemiplegia on the right from pressure on, or hæmorrhage in the left cerebral peduncle; some degree of Parinaud's syndrome from hæmorrhage into, or ischæmic softenings in the tectum due to compression of the supplying vessels; interruption of the frontopontine pathways evidenced by suprasegmental paresis of conjugate ocular movements (for comparison see Figs. 18 and 19).

Extraocular muscle palsies.—As has been stated involvement of the third nerve usually is peripheral, but it is impossible to estimate how often there is some involvement within the brain stem. Extension of a subdural hæmatoma to the base can produce pressure on the cavernous sinus through which the nerves pass to the extra-



Fig. 27.-A 52 year old man was knocked down ir a fight. He survived for nine days. A subdural hematoma on the left was evacuated. Pressure a sainst the base of the skull seemingly accounted for ischæmic softenings in the left half of the chiasm.

ocular muscles. Fourth and sixth nerve palsies are not encountered as often as third nerve involvement. All such palsies may originate within the brain stem.

#### Conclusions

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This paper does not lend itself to summarizing. An effort has been made to explain ocular signs associated with trauma to the skull affecting blood vessels. Several generally well known clinical entities have been described particularly from the standpoint of ocular symptomatology, and an effort has been made to explain the basis of the signs.

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# RÉSUMÉ

La présente publication traite des traumatismes craniens ayant entraîné des lésions vasculaires avec une description particulièrement détaillée de la symptomatologie oculaire qui en résulte.

I. - Fistules carotido-caverneuses. - La artérioveineuse dans le sinus caverneux est la cause la plus fréquente de l'exophtalmie pulsatile. L'étiologie en est le plus souvent un traumatisme, entraînant une rupture de l'artère carotide à l'intérieur du sinus caverneux, mais il appert que parfois cette rupture peut être spontanée. Des études faites sur un grand nombre de cas études faites sur un grand nombre de cas montrent que le rapport entre ces ruptures spon-tanées et les ruptures traumatiques est de 1:3. Les traumatismes fermés sont souvent cause d'une Les traumatismes fermes sont souvent cause traine fracture de la base, qui n'est pas toujours visible aux rayons X, associée à une lésion vasculaire. Un autre facteur dont il faut tenir compte est l'existence possible d'un anévrysme congénital de l'artère carotide, secondairement rupturé; d'une façon générale, il convient de souligner qu'il n'est pas toujours facile de distinguer entre une rupture spontanée et une rupture traumatique, surtout si la notion de traumatisme est ancienne. Du point de vue anatomo-pathologique, la communication artérioveineuse dans le sinus, provoque une dilatation de ce dernier et un épaississement de sa paroi, ainsi que des veines céphaliques qui en sortent; le chemin de drainage le plus fréquent est celui des veines ophtalmique supérieure, faciale et jugulaire interne. La symptomatologie consiste en: un bruit (c'est à dire un bruit senti ou entendu par le patient à l'intérieur de sa tête), l'existence d'une pulsation de l'exophtalmie, de la diplopie, des maux de tête, des troubles du fond de l'œil, de la tension oculaire et enfin, il peut dans certains cas, exister des symptômes contra-latéraux. Le cas, exister des symptomes condariateda. Le proposition de l'exophtalmie. Ce bruit peut parfois ne pas être perçu par le malade, mais il reste audible à l'auscultation des yeux: il est synchrone aux battements cardiaques; lorsqu'il est bilatéral, le côté atteint est généralement celui où il est le plus fort. Ce bruit peut enfin être supprimé par la compression de l'artère carotide du même côté au niveau du cou. Pour ce qui est de la pulsation, on considère généralement que celle-ci est plus facile à palper qu'à voir: en fait elle est plus facile

à constater au niveau des veines dilatées de la paupière. L'exophtalmie est le plus fréquemment unilatérale et homolatérale. La diplopie résulte de l'association de l'ésions à des nerfs craniens. Les maux de tête semblent être d'une acuité variable: ils peuvent parfois apparaître très brusquement, sans doute à la suite d'une rupture spontanée. Les troubles de la vision sont fréquents: une perte totale de vision de l'œil atteint survient dans 20% des cas: ce n'est que très rarement qu'il n'existe aucune lésion du fond de l'œil. La thérapeutique doit être précoce; de nombreuses interventions ent été proposées et essayées avec des résultats variables: à l'heure actuelle la tendance est de ligaturer l'artère carotide dans le crâne et dans le cou, et de ligaturer en plus l'artère ophtalmique.

Les auteurs discutent alors quelques unes des complications qui peuvent survenir lors des artériographies carotides. Trois cas personnels de blessures chirurgicales de la carotide sont présentés, cas ayant entraîné des complications oculaires avec troubles de la vision.

II. — Hématomes extraduraux et sous-duraux. — Dans ces deux syndromes, la symptomatologie peut être décrite comme très semblable. Ces lésions sont cataloguées sous trois chefs: l'hématome extradural, résultant d'une hémorragie par rupture d'une branche de l'artère méningée moyenne; l'hématome sous-dural aigu, résultant toujours d'un traumatisme; l'hématome sous-dural chronique, uni ou bilatéral, peut parfois former une véritable capsule de sang coagulé.

Hématome extradural. – Du point de vue anatomo-pathologique, il faut se souvenir que l'artère méningée moyenne se divise, après avoir pénétré dans le crâne, en branches antérieure et postérieure. La branche antérieure, qui croise l'angle inféro-interne du sphénoïde est la plus souvent lésée. La symptomatologie comporte: une perte de conscience de durée variable; puis survient une période de latence, durant laquelle il y a reprise de conscience avec amélioration générale, à tel point que l'on peut penser que la guérison est en bonne voie; apparaissent ensuite, des signes d'augmentation de la pression intracranienne, suivis de coma et de la mort si un traitement n'est par institué. Les signes de l'augmentation de la pression intracranienne sont: les maux de tête, les vomissements et la somnolence; des convulsions, contralatérales, une hémiplégie, de la température peuvent survenir. La mydriase, permanente ou transitoire est homo ou contralatérale; le réflexe pupillaire à la lumière est aboli.

Hématome sous-dural aigu.—La symptomatologie est, dans ces cas, extrêmement variable, selon la nature du traumatisme. Plusieurs points sont discutés ici à ce sujet.

Hématome sous-dural chronique.—Fréquence—Ces hématomes s'observent chèz des enfants entre la naissance et l'âge de deux ans, et chez les adultes à partir de l'âge de 20 ans: il y a donc une période de la vie où le syndrome ne se rencontre pas. La raison de ceci est inconnue. Symptomatologie.—Chez les enfants, on assiste à des convulsions et à une augmentation progressive de volume de la tête, avec gonflement des fontanelles le liquide céphalo-rachidien est sanglant ou xanthochromique. Chez l'adulte, les maux de tête, la somnolence, la confusion mentale, l'irritabilité sont caractéristiques. A cela s'associent souvent des nausées, des vomissements, du vertige, de la diplopie, des pertes de vision et d'audition, des convulsions et une hémiparésie. Les signes oculaires sont exposés et discutés alors en détail.

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#### ANORECTAL LYMPHOMAS

J. Y. McGRAW, M.D., and J. L. BONENFANT, M.D., F.R.C.P.[C], Quebec City

ANORECTAL LYMPHOMAS are being reported with increasing frequency. In 1952 a total of 228 cases were recorded by Hayes and Burr.4 Because of their unusual development of lymphomatous growths in the anorectal region, it is of the greatest importance to recognize that an essentially favourable prognosis characterizes well defined solitary lymphoid tumours, termed benign lymphomas when originating in the distal rectum or anus. The four cases reported here are examples of this specific lesion; they were seen in the last 10 years and taken from the files of the Department of Surgical Pathology, Hôtel-Dieu de Québec and Faculté de Médecine, Laval University.

As indicated in Table I, all our patients were adult young men. Their chief complaints were soreness, painful defæcation, bleeding and prolapse, most of which could be referred to the concomitant associated pathologic lesions. In all instances the tumours were in the rectum (the lowest being 3 cm. and the highest 6 cm. from the anus) single, sessile and of a size ranging from pea to hazel nut (the smallest being 1.5 cm. and the largest being 2.5 cm. in diameter). The tumour first detected by digital examination was seen easily in all cases through the rectoscope. All laboratory tests carried out, including roentgenologic study of the colon were negative.

All tumours were removed by simple excision; a meticulous follow-up to date has shown no recurrence. In one case hæmorrhoids, which were not removed at the time of the operation, were subsequently excised five years later. All microscopic reports confirmed the presence of the clinically diagnosed associated pathology and on histologic examination all rectal polyps were diagnosed as anorectal lymphomas.

#### PATHOLOGY

Grossly, anorectal lymphomas appear as solitary, sharply circumscribed sub-mucous nodules or broad based polypoid tumours

of about one to two centimeters in diameter, freely movable and covered with normal mucosa. Their surface, although variously described at times as polypoid, (Fig. 1) papillary or lobulated, is smooth as a rule and also movable. Ulceration and erosion of the surface are very uncommon and when present are generally not extensive. Their consistency is mostly soft; it may occasionally be firm but never hard. The cut surface appears usually grey or salmon colour and homogeneous.

Microscopically they are revealed as discrete tumours consisting largely of lymphoid tissue resembling normal lymph node, except for absent sinusoids. The overlying mucosa, which as previously mentioned, is almost always entirely normal, may show signs of pressure atrophy and be infiltrated with lymphocytes (Fig. 2).

The main lesion is submucosal and, as stated by Hayes<sup>4, 5</sup> in an extensive study on the subject, was comprised of lobules of



Fig. 1.—Low magnification view of resected specimen.

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TABLE I.—CASE REPORTS

Sex	Age	Symptoms	cm. from anus	Size in cm.	Gross aspect	Associated lesions	Treatment	Recur- rence	Foll w up (years)
M	38	Pain at stool Bleeding	4	1.0	Sessile polyp	Hæmorrhoids	Polypectomy Hæmorrhoidectom	None	10
M	27	Prolapse Bleeding	3	1.5	Sessile polyp	Hæmorrhoids	Polypectomy	None	7
M	55	Ache at stool Bleeding	2	1.0	Sessile polyp	Hæmorrhoids	Polypectomy Hæmorrhoidectom	None v	4
M	47	Sharp pains Acute hæmorrhoids	5	2.0	Sessile polyp	Hæmorrhoids Fistula	Polypectomy Hæmorrhoidectom Fistulectomy	None y	2

lymphoid tissue. Their lymphoid follicles have germinal centres with mitotic figures and large histiocytic cells containing phagocytized cellular debris. This feature establishes the very specific pattern of lymphomas. These lobules have no capsules and the lymphoid tissue does not extend into the muscularis propria.

#### SYMPTOMATOLOGY

Lymphomas are found predominantly in men (75%) in an age range of 25 to 50 years and more especially in young adults with an average age of 33 years.

The clinical manifestations (Table I), which are often varied and embrace any of the symptoms referable to ano-rectal pathology, were present in most of our cases, however for less than two years. The most frequent complaint encountered is undoubtedly soreness or even persistent pain in the rectum associated or not with anal pain or tenderness. In many cases it is possible to establish that pain is felt mostly at stool, or that an ache persists after defæcation with or without anal discomfort and occasionally pruritus. Protrusion or extrusion of a mass sometimes only at stool, coinciding frequently with the presence of protruding and bleeding hæmorrhoids, has also been reported in the case of larger tumours, but a true prolapse must still be regarded as very unusual.

Rectal examination will usually reveal lymphomas slightly above the anorectal junction or dentate line and without special predilection for any particular site on the rectal wall; they can be found anywhere from the anus to about 10 cm. above the mucocutaneous junction, but however, are generally within the reach of the examining finger. Barium enemas are always reported

negative and in none of our cases nor in those previously reported was there any coincidental lesion located at a higher level in the sigmoid colon.

#### COURSE AND PROGNOSIS

A follow-up to date of our cases has shown no recurrence of the excised tumours. A complete review of the literature shows that such results generally apply to all the cases recorded, although in a few instances lymphomas developed subsequently in a different site. Their prognosis is excellent: anorectal lymphomas are essentially benign, and in no instance have they given rise to localized or generalized malignant lymphoma of any type.

#### TREATMENT

In view of the foregoing study, there is no doubt in our mind that simple excision of the lesion is the only advisable and recommended treatment. There seems to be absolutely no indication here for a wide surgical extirpation preceded or followed by radiotherapy. Some reports claim that small lesions can be destroyed by fulguration as an office procedure; we are inclined to disapprove of this, since in these instances biopsy becomes impossible and no pathologic confirmation of the preoperative clinical diagnosis can be obtained.

#### DISCUSSION

In commenting on the genesis of anorectal lymphomas it must first be established whether the lesion is a benign lymphoid hyperplasia or a neoplasm involving and enlarging lymph follicles of the area. The answer to such a question although still unknown, would bring much light on the

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Fig. 2.-Low power view of lesion showing normal mucosa and lymphocytic infiltration.

etiopathology of lymphomas of the anorectum.

It is of special interest in discussing the physiopathology of this lesion to point out that in no instances were there any appreciably enlarged lymph nodes, concomitant enlargement of tonsils, spleen or liver, or history of appendectomy.

Lymphomas occur commonly in the rectum because of the large concentration of lymphoid follicles in this area (approximately 4% per square cm. in the submucosa of the distal colon according to Dukes and Bussey<sup>1</sup>). Granet<sup>2</sup> in support of the theory of hyperplasia, suggests that lymph follicles of the anorectal region are chronically exposed to multiple sources of irritation such as fæcal pathogens, high alkalinity of the region, ranging from pH 8 to pH 10, and repeated trauma of defæcation. This may be so because the lymph follicles penetrate the muscularis mucosæ, and are separated from the lumen of the bowel only by the mucosa.3

Moreover the importance of infection in

the anorectal region must also be considered. In the genesis of anorectal lymphomas it is our opinion that there is an important if not evident connection between the lesion and adjacent pathology. The development of lymphomas would be related to such local lesions as hypertrophied papillas, hæmorrhoids, inflammation of rectal papillas of perianal crypts, fissures, fistulas, and other local lesions. Anorectal lymphomas would therefore be nonspecific tumorous lymphoid hyperplasias essentially benign. Such an explanation may probably not be generally accepted; but the relatively normal appearance of the follicular structures and the frequent presence of phagocytic cells within the follicles seem to suggest a hyperplasia rather than a tumour.

#### CONCLUSION

Four cases of discrete solitary tumour arising in the anorectum and made up largely of lymphoid tissue diagnosed microscopically as benign lymphoma are reported.

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All such lymphoid anorectal growths, showing a lobular pattern with primary follicle formation and reaction centres, were histologically reported as being essentially benign and are to be considered so, since they all have proved harmless when correlated with the subsequent course of the patient.

There is evidence that anorectal lymphomas differ radically from malignancies encountered in the rectum or anus, that they do not degenerate in malignant lymphomas or even reoccur after removal and that consequently a more radical treatment other than simple excision of the lesion is not

necessary or even acceptable.

Finally, because its histologic structure suggests lymphoid hyperplasia rather than tumour, it is our present concept that anorectal lymphoma should be considered as benign nonspecific tumour-like lymphoid hyperplasia intimately connected with and dependent upon neighbouring local lesions.

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#### RÉSUMÉ

Quatre cas d'adénolymphomes bénins de la région ano-rectale font le sujet de ce travail. Ces tumeurs diffèrent totalement des lymphosarcomes que l'on peut rencontrer au rectum et à l'anus et une simple exérèse est suffisante. Ces lésions sont plutôt d'ordre hyperplasique que néoplasique.

CLINICAL INVOLVEMENTS. H. Gardiner-Hill, Consulting Physician to St. Thomas's Hospital, London, England, 200 pp. Illust. Butterworth and Co. Ltd., London, England; Butterworth & Co. (Canada) Ltd., Toronto, 1958. \$6.50.

Before attempting any form of criticism, one must accept the author's statement that "Clinical Involvements" is not really a book. Then only, can one assess the work in terms of the author's objectives of illustrating clinical points such as approach to a case, development of clinical sense, the importance of some of the more subtle and often poorly managed aspects of clinical medicine, for example, the handling of the patient with psychosomatic

disorder, etc.

The primary value of Dr. Gardiner-Hill's effort, in my opinion, is that he has provided for the senior medical student, general practitioner or postgraduate physician, a colourful series of clinical incidents which summarize many of the lessons which medical teachers often stress in the course of bedside clinics or teaching rounds. Here is an attempt to instil in the mind of the physician a practical awareness of the many facets which contribute to clinical acumen of real value when one comes to assume the personal responsibility for management of a patient.

The informality of the style employed by

the author allows the reader quietly to absorb the point being stressed in the particular clinical involvement described. Thus perspective and avoidance of clinical myopia, especially amongst specialists, the true meaning of signs and symptoms, the value and pitfalls of history taking, the importance of analysis of the history, the usefulness of analogy between systems, the clinical limitations of radiology, pathology, biochemistry, are all stressed in giving the physician a true appreciation of the clinical situation leading to the diagnosis, on which treatment is based. Further, the author convincingly develops the philosophy of consideration of the patient as a human being, in deciding what or how much told to the individual patient should be concerned.

Finally the reader is provided with a large number of objective scientific facts and concepts of academic importance to lend strength

to this unusual type of publication.

Within the limitations stated by the author, this should be of real interest and stimulation to a wide medical readership, particularly among younger physicians in training. Possibly it will also serve some older members of the profession as a somewhat nostalgic reminder of the processes involved in their own development as physicians.

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# INFECTION FOLLOWING SPLENECTOMY IN INFANTS AND CHILDREN

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This study was stimulated by reports in the literature of an unusually high incidence of severe infections in young children following splenectomy.<sup>5,8,18</sup> The connection was first suggested by King and Shumaker<sup>9</sup> in 1952, and has received comment from several authors since then. The present report is a review of 35 cases of splenectomy in children at the Vancouver General Hospital from 1945 to 1959.

King and Shumaker reported five severe infections following splenectomy in a series of approximately 100 cases. Four of these children developed meningitis or overwhelming meningococcæmia in from six weeks to three years after operation, with one death. The fifth child died from a rapidly fatal febrile illness. These severe infections occurred only in infants (all five were six months of age at the time of splenectomy) and only in those who had congenital hæmolytic anæmia.

In 1954 Glenn et al.4 reported a series of 27 splenectomies with no subsequent infection. They had a minimum follow-up of one and one-half years. Other authors however, report severe infection.2, 5, 7, 16, 17, 19 Of 72 splenectomies reviewed by Walter and Chaffin,19 four serious infections resulted, with three deaths. However, they did not feel that there was any evidence of increased susceptibility to infection, or increased mortality when this operation was performed in infancy. It is interesting to note that while in their series there was only one infection in patients with congenital hæmolytic anæmia, there were three deaths from infection in a much smaller group of nine splenectomies for Gaucher's disease and Mediterranean anæmia. 19

In their extensive review of 207 cases of splenectomy from 1930 to 1954, Gofstein and Gellis concluded that there was indeed some correlation between splenectomy and severe sepsis, but no specific relationship between age at splenectomy and sepsis. They excluded 100 cases from their series because these patients were felt to have some prior defect in their immune defence

mechanism (e.g. portal hypertension, storage diseases, etc.). They reported a total of four serious infections with three deaths in the remaining 107 splenectomies (62 for congenital hæmolytic anæmia, 23 for idiopathic thrombocytopenic purpura, 18 for trauma and four for Cooley's anæmia).

In 1957 Smith et al.17 reported 19 cases of severe infection after splenectomy in children, an incidence of 28%. Smith found that the various post-splenectomy infections fell into several categories: (1) those associated with meningitis, (2) those with acute pericarditis and (3) a group of acutely ill children with fulminating septicæmia. As in the cases reported by others the pneumococcus was the most frequent organism present (six cases). Their work substantiates the conclusion of Gofstein and Gellis that while there appears to be a correlation between splenectomy and sepsis the relationship seems to be independent of age.

A recent review by Huntley<sup>8</sup> of 58 cases of splenectomy found seven infected patients of whom five were under one year old; however, four of the five might be considered to be prone to infection because of the nature of the underlying condition.<sup>5</sup>

Studies by Gitlin, as quoted by Gofstein and Gellis,5 reveal that there does not seem to be an impairment of the capacity of splenectomized children to form antibodies. There is some evidence suggesting that in certain animal species splenectomy decreases the natural resistance to acute and chronic infection. The effect of splenectomy on the mortality rate from a spontaneously acquired infection with Bacillus enteritides was studied by Morris and Bulloch in 1919.11 In their experiments they demonstrated that there was a temporary decrease in the resistance of the rat to infection following splenectomy (85% died with splenectomy, 29% died in control).

While many animal experiments may substantiate this, it is difficult to apply these findings to the patient, not only because experimental findings must be applied from one species to another, but also because the exact function of the spleen in man is not clearly understood. The relationship of the spleen's role to infection is suggested by several clinical findings: (1) the spleen tends to enlarge in the presence of certain infections and (2) lymphocytes have been demonstrated to play a major role in antibody formation, and as the spleen is the largest reservoir of lymphocytes, it would appear to play a leading role in the defence. Rowlev14 reported studies of antigenantibody titres in which 13 of the 14 splenectomized patients failed to show a significant rise in antibody titre after intravenous antigen injection. Gofstein and Gellis studied gamma globulin levels in several of their patients following splenectomy. They found that there did not appear to be a quantitative change in these levels, nor in the levels of patients who developed infection after splenectomy.5

#### CASE REPORTS

Case 1.—R.R.—boy aged five days. This patient underwent splenectomy in 1955 at the age of five days. The spleen was removed in the process of repair of a diaphragmatic hernia. He had an uneventful postoperative course and was discharged at age 19 days.

The patient was next seen at the age of ten and one-half months when he was admitted to hospital with acute bronchiolitis. Temperature ranged from 101° F. to 102.5° F. On the third day he began to respond to antibiotics and became afebrile on the fifth day. He was discharged on the ninth day.

At the age of 15 months the patient was seen in the emergency department. He was acutely ill with a history of two days' duration of coughing and irritability: temperature on admission was 105° F. He was treated with salicylates and sponge baths and heavy doses of penicillin. He responded rapidly to this therapy and was discharged on the fourth day after admission. No definite diagnosis other than P.U.O. was made.

The patient had no further admissions to hospital. No follow-up after discharge was obtained.

Case 2.—S.K., a boy aged two years. At age one year and 11 months this patient was admitted to hospital in 1950 with severe ac-

quired hæmolytic anæmia (Lederer type). He received several blood transfusions and was discharged two weeks later with hæmoglol in level 60%. He was readmitted two weeks later with Hb. 28%. The patient was transfused up to 58% Hb. and splenectomy was performed. The postoperative course was uneventful and the patient was discharged seven days after operation, but he was readmitted one morth after discharge. At this time his Hb. was 3%. He had tonsillitis and cervical adenitis which responded well to treatment with chlortet acycline and blood transfusions. He was discharged on the 10th day with Hb. 57%.

He was well until the age of 10 years when he was seen in the emergency department, acutely ill, and in a state of shock with temperature of 106° F. In spite of heroic procedures including intravenous antibiotics and corticoids, he died two hours after admission. Blood cultures taken just before death were positive for pneumococci. Autopsy revealed fulminating bronchopneumonia, pneumococcal meningitis and septicæmia, with bilateral adrenal hæmorrhages. Cultures of the C.S.F. and blood were again positive for pneumococci.

Case 3.—J.B., a boy aged seven years. At six years and 10 months of age this patient was admitted to hospital for investigation of thrombocytopenia. He had been known to have thrombocytopenic purpura since the age of three and one-half months. He had responded well to conservative therapy and surgery was felt to be inadvisable. During this period of investigation he was quite well, other than a platelet count of 30,400/c.mm.

While waiting decision on operation he developed a right upper lobe pneumonia. This responded well in four days to penicillin, which was continued up to, and after the splenectomy. He underwent splenectomy in 1946 on the 40th day after admission. He did well until the ninth postoperative day when he developed bronchopneumonia. The dose of penicillin was increased. He ran a temperature of 101.5° F. to 103° F. for five days. He recovered from this bout of pneumonia and remained on penicillin. However, on the 20th postoperative day he developed a high spiking fever to 105° F. For the next four days he continued to be desperately ill with a continued high fever of 103° F. to 106° F. On the 24th postoperative day he was diegnosed as having pneumococcal meningitis, (pneumococci type 18). His condition emained poor and in spite of massive doses of penicillin by all routes, including intrathe al

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penicillin and other broad spectrum antibiotics, he lapsed into coma and died on the 68th postoperative day.

Case 4.-R.R., a boy aged 12 years. At this age the patient underwent splenectomy for ruptured spleen in 1956. He had been in good health prior to this injury. He tolerated the or eration well and had an uneventful postof erative course. He was discharged on the ei thth postoperative day.

Two years later he was admitted to hospital with acute epididymitis. This responded well to moderate doses of chloramphenicol and he was discharged on the fifth day.

He was well for 10 months, but was then

again admitted to the hospital with acute epididymitis. This again responded to chloramphenicol. He was discharged on the seventh day and has been well for the past year to the present time.

Case 5.-P.K., a girl aged 15 years. This young woman was admitted to hospital in 1956 with a head injury and ruptured spleen resulting from a traffic accident. On admission she was comatose and in a state of shock. She underwent emergency splenectomy four hours after admission. Her injury to the head and brain stem was treated conservatively.

She remained in comatose condition and developed staphylococcal septicæmia on the ninth day. She was placed on heavy doses of penicillin and erythromycin. Blood and C.S.F. cultures continued to grow coagulase-positive staphylococci. Her condition remained poor until her death on the 200th day.

Case 6.-L.W., a girl aged two years. This Chinese girl underwent splenectomy at the age of two years for what was thought at the time to be hæmolytic anæmia. Prior to splenectomy in 1950 she had been well except for

One year after splenectomy she was hospitalized for primary atypical pneumonia. This was treated with penicillin and responded well in four days. Over the next one and onehalf years she was admitted to hospital eight times for blood transfusions and investigations of anæmia, which was finally diagnosed as Cooley's anæmia.

At age four and one-half years she was admitted to hospital with fever. This remained undiagnosed but responded to penicillin. Over the next four years she had six admissions for recurring infection; three for acute upper respiratory infection; one for recurring tonsillitis and two for severe bronchopneumonia. Since her last admission she has had frequent sore throats, but has been well otherwise except for quite severe attacks of chickenpox and measles.

# DISCUSSION

In this series of 35 cases of splenectomy, 13 were for trauma, 10 for thrombocytopenic purpura, and seven for hæmolytic anæmia. Of the 35 cases, complete follow-up to the present time was obtained in 23. Five other cases were followed up for two years, two cases for six months and in the remaining five no follow-up was obtained.

In the 35 cases six patients subsequently had infections which we feel are worthy of further comment. Cases 2, 3 and 5 present the picture of overwhelming infection commented upon by Smith, the first two of these caused by the pneumococcus. In Case 3 the patient had a proven pneumococcal pneumonia prior to operation. The pneumonia was treated with penicillin and a satisfactory response obtained. The patient remained on this therapy up to and after splenectomy, but in spite of this developed meningitis.

Case 6 is included because it is felt that even though the patient had severe anæmia, which might predispose to infection, she had no infections prior to splenectomy at age two years. Following splenectomy she had two bouts of severe bronchopneumonia and several episodes of severe upper res-

piratory infection.

Cases 1 and 4 demonstrate infections occurring 14 and 24 months respectively post-splenectomy in which there was no generalized disease and where a ruptured spleen was removed.

None of these six patients who developed infections was felt to have any underlying condition which impaired the immune mechanism. This would include Case 5 despite the presence of severe head injury.

#### SUMMARY AND CONCLUSIONS

From this series we feel that there is a strong suggestion of increased incidence of infection in children following splenectomy. Older children, as well as infants, appear to share this increased susceptibility. It would appear to be particularly dangerous to perform splenectomy in children who have had a recent upper respiratory infection or pneumonia. This was originally suggested by Gofstein and Gellis<sup>5</sup> and also

noted by Huntley.8

An incidental finding noted in our followup study was that several of the patients who developed mumps, measles or chickenpox seemed to be more acutely ill than one would expect. These were patients other than the reported cases of infection.

In the light of these findings and those of others, it would seem to be worthwhile to reconsider the indications for splenectomy in childhood. The possibility of subsequent severe infection should be kept in mind, and this may be particularly true in infancy. We feel that it is a further stimulus to exhaust all available conservative measures in the management of blood dyscrasia amenable to splenectomy, and in questionable cases of traumatic rupture of the spleen. Splenectomy may appear to be an easy and immediate solution to a problem, but it may eventually lead to grave consequences.

It is also important that every child undergoing splenectomy should be checked for many years in order to throw further

light on this problem.

A discussion of the literature pertaining to the possibility of increased infection following splenectomy in children has been presented.

The case histories are presented of six cases of significant infection following splenectomy in childhood.

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#### RÉSUMÉ

Le présent travail a été fait à la suite de rapports indiquant dans la littérature une augmentation anormale des infections graves chez des jeunes enfants après une splénectomie. Il s'agit d'une revue de 35 splénectomies faites chez des enfants entre 1945 et 1959 et à l'Hôpital Général de Vanconver.

Expérimentalement, il a été possible de démontrer que la splénectomie chez le rat diminualt les capacités de résistance à des infections induites; il est cependant difficile d'appliquer ces conclusions à l'homme, d'une part à cause des différences qui peuvent exister entre espèces, mais encore parce que le rôle de la rate chez l'homme est à peu près inconnu. Cependant, certains faits cliniques suggerent fortement une relation en recet organe et les infections; tout d'abord, la rate est hypertrophiée dans certaines maladies; de plus, la rate est le plus important réservoir de lymphocytes de l'organisme et peut donc influencer de cette façon les décharges d'anticorps. Par mi

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n er ar ni les cas qui sont présentés ici, (35), la splénectomie avait été pratiquée pour traumatisme dans 13 cas, pour purpura thrombocytopénique dans 10 cas et pour anémie hémolytique dans sept cas. A plus ou moins longue échéance, des complications infectieuses graves, parfois mortelles, apparurent dans six cas: il y eut quatre cas de pneumonies dont un compliqué de méningite à pneumocoques, un cas d'épididymite à répétition et un cas de senticémie à staphylocoque.

D'une façon générale, l'étude de cette série suggère fortement une augmention de la morbidité infectieuse après splénectomie. Il semble tout spécialement dangereux et contre-indiqué de procéder à une splénectomie chez des enfants qui présentent ou ont récemment présenté des troubles infectieux respiratoires ou pulmonaires. De plus, chez les splénectomisés, les maladies telles les oreillons, la rougeole ou la varicelle, prennent une allure clinique beaucoup plus aigué et grave.

# MALIGNANT MELANOMA OF THE SKIN: A VALUABLE PROGNOSTIC GUIDE IN THE CHOICE OF CASES FOR PROPHYLACTIC LYMPH NODE DISSECTION

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The Generally accepted method of treatment for malignant melanoma in this hospital has been local excision of the primary, a regional lymph node dissection not being performed unless, or until the nodes become clinically involved. Many articles in recent years have advocated more radical methods of treatment and indicated improved results. It was therefore decided to make a critical analysis of the results of treatment in this hospital, trying in particular to clarify the justification, if any, for local excision alone, in all or in certain cases.

There are many articles covering this and other aspects of the treatment of malignant melanoma, but the results obtained in a general hospital are of interest for two main reasons. Firstly, the material contained in reports from cancer centres naturally shows a large proportion of advanced cases which serve to produce a disproportionately bad overall prognosis, as well as containing many referred cases where initial inadequate treatment has been followed by recurrence.1 Secondly, by studying the material available at this hospital we have attempted to answer certain questions relating to prognosis and the natural history of the disease, which are of importance in the choice of surgical treatment. With these objectives in mind, it was therefore decided to include in the study only those cases which received initial treatment at this hos-

#### MATERIAL

A survey was made of all cases of malignant melanoma admitted to this hospital between 1929 and 1958, but excluding orbital and conjunctival melanoma. This provided a total series of 162 malignant melanomas and 11 juvenile melanomas, the microscopic sections of which were available. However, 14 patients with malignant melanoma were not treated initially at this hospital, thus leaving a total of 148. A detailed five year follow-up was obtained on 92 patients admitted between 1929 and 1954. Many of this group provided a 10 year follow-up. Therefore, the term "five year follow-up" covers all cases of recurrence within 10 years, if such a follow-up period was available. Only approximately 15% of the recurrences were found to occur later than five years, but these were included in order to give a more realistic long term prognosis.

#### RESULTS

Site.—Classification of the primary site is illustrated in Table II, the distribution being very similar to the figures of other authors.<sup>2, 3</sup>

Sex.—As part of the general survey of the material, a study of sex incidence was made and is summarized in Table III.

<sup>&</sup>lt;sup>o</sup>From the Department of Pathology and Tumour Clinic, The Montreal General Hospital.

<sup>†</sup>Juvenile melanoma refers to particular melanomas occurring before puberty, having malignant morphology but known to be benign in behaviour. Melanomas with similar morphology can occasionally be identified post-pubertal.

TABLE I.—FIVE YEAR SURVIVAL, FREE OF DISEASE

	Method of Treatment	Number of Patients	Number of Survivals	Percentage Survivals
A.	Local excision, nodes clinically not involved	63	46	73.0
В.	Local excision and regional node dissection, nodes clinically			
	involved	18	5	27.8
C.	Prophylactic lymph node dissection	3	1	33.3
D.	Untreated cases and deaths from other causes	8	0	0.0
	Number of patients	92		
	Number of patients treated	84		
	Number of survivals	52		
	Percentage of survivals of treated ca		9	

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In contrast to the rough equality in incidence between the sexes in the series of 92 cases, the incidence of juvenile melanoma occurring in the total series of 174 showed a ratio of three boys to one girl in a total of 11 cases, which is admittedly small.

TABLE IV.—Local Excision—Nodes Clinically Not Involved

Size of Primary in	Number of	Five Year Survival Free of Disease Number of						
Centimetres	Patients		Percentage					
0.0 - 0.5	15	15	100.0					
0.5 - 1.0	16	13	81.2					
1.0 - 2.0	16	12	75.0					
2.0 and over	16	6	37.5					

Of great interest is the markedly longer survival time in women than in men dying of the disease, a fact that has been studied in detail by White<sup>4</sup> as well as being recognised by other authors. However, the number of men and women remaining free of the disease at five years was roughly equal.

Size and Depth of Primary. Of the 92 cases, 63 were patients who had had local excision of the primary only, the regional nodes not being involved clinically. These cases were analysed first. It has long been known that the diameter of the primary lesion provides a fair guide to prognosis regardless of the type of treatment as illustrated in Table IV.

TABLE III.

Number of		Five year free of d	Average survival time following initial treatment	
cases		No. of cases	% of total	in fatal cases
Men	43	23	53.5	21.3 months
Women	49	29	59.2	34.7 months

In studying the cases in which regional nodes were clinically not involved at the time of initial surgery, it became apparent that there was a significant variation in behaviour among the tumours of large size, the majority carrying a very poor prognosis, but several showing no recurrence of the disease at a five year, or even 10 year follow-up.

TABLE V.—Local Excision—Nodes Clinically Not Involved

		Five Year Free of	Survival Disease			
Histological Depth	Number of Patients	Number of Patients	Percentage			
Stage I	23	22	95.6			
Stage II	16	14	87.5			
Stage III	24	10	41.6			

It was therefore decided to classify the primary tumours according to microscopic depth of invasion, three groups being chosen for purposes of classification. These are graded Stages I, II, III.

Stage I, are those tumours showing distinct malignant features, the process being confined to the epidermis and junctional level.

Stage II, those showing dermal invasion to a depth not extending beyond the sweat glands.

Stage III, are all those lesions showing invasion to any depth beyond the sweat glands.

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TABLE VI.—LOCAL EXCISION—NODES CLINICALLY NOT INVOLVED

Size of Primary	Stage I	Stage II	Stage III	Percentage of Five Year Survival Free of Disease
0.)-0.5 cm	10	3	2	100.0
0. i - 1.0 cm	7*	6*	3*	81.2
1.0 - 2.0 cm	3	5*	8***	75.0
2.0 and over	3	2	11*****	37.5
Percentage Of Five Year Survival Free of Disease*  * cases developing metastases.	95.6	87.5	41.6	

In establishing these groups those lesions of questionable malignancy were excluded from the series. The standard criteria of malignancy in melanoma were used, namely cytologic features, mitotic activity, presence of junctional change and intraepidermal invasion, and associated inflammatory reaction.

With this classification established, it proved to be a remarkably accurate prognostic guide. The tumours in the Groups I and II, both large and small showed an almost complete cure rate when local excision only was employed in cases when regional nodes were clinically not involved. The one exception in Stage I was a lesion 0.7 cm, in diameter on the foot of a man of 45 years who was apparently quite well for three years following surgery until succumbing suddenly to hæmatogenous metastases. In Stage II, one exception is a woman who developed regional node metastases (six years after removal of the primary on the cheek and who is now free of further recurrence for three years following radical neck dissection. The second exception was a woman who developed inguinal metastases during pregnancy six years after removal of the primary on the calf. She subsequently died of metastases eleven years after initial surgery.

It might be argued that classification by depth merely illustrates the same prognosis as classification by the size of the primary lesion.

Table VI is a combination of Tables IV and V, and illustrates clearly that the classification by depth of invasion is of greater prognostic value than is the classification by size. Here it is seen that the large lesions with good prognosis are those not penetrating beyond the sweat gland

level. Conversely, the majority of small lesions with bad prognosis are found in Stage III showing penetration beyond the sweat gland level.

Further examination was next carried out to determine the fate of those cases classified as Stage III who underwent local excision only, regional nodes not being clinically involved. As can be seen in Table V, the percentage five year survival for this group was 41.6. One case in Stage III is alive and apparently free of disease three years following excision of regional node metastases. Of the other 13 cases in Stage III none survived five years free of disease following further surgical treatment of their metastases, 10 first developed regional node metastases and three hæmatogenous metastases. The average survival period was months following development of lymphatic metastases, and four months for the group developing hæmatogenous metastases. The average period between initial operative treatment and the development of the metastases was 26 months.

The results in the small group with prophylactic node dissection are insufficient to justify comment. The results in the group with local excision and regional node dissection for clinically involved nodes represent some superficial node, and some radical node dissections and again form too small a group for detailed analysis.

#### DISCUSSION

In making a comparative study of cases of malignant melanoma dating back to 1929, it is instructive to note how the average severity of the lesion has changed. A change is also noted in the length of time of symptoms prior to surgical treatment. In the period 1929-1938, 70% of the lesions treated were greater than 2 cm. in

diameter and the average time of symptoms of rapid growth, ulceration or repeated hæmorrhage prior to surgical treatment was 10.5 months. In contrast, cases treated between 1949-58 show over half the lesions to be 1 cm. or less in diameter and the period before surgical treatment, 5.8 months. Thus, the results in any such series as the one given here must accept progressive improvement in results regardless of method of treatment, which is not perhaps adequately illustrated when such a large span of years is considered as a single group.

Therefore, it is not proposed to place much emphasis upon percentage results in this group except to remark that the overall good results are probably a reflection of the vastly increasing number of early lesions treated, many of which were only recognized as malignant when examined microscopically. The cytologic features of malignancy in melanoma are known to provide no accurate or useful guide as to prognosis in determining the probability of an individual case developing regional lymph node metastases. Furthermore, the occurrence of hæmatogenous spread is even more unpredictable.

When deciding on the treatment of choice, much emphasis quite rightly has been placed on the high incidence of regional node metastases demonstrable only by careful microscopic examination.1, 5-7 If this factor and the size of the primary lesion alone are the guide for justifying prophylactic regional node dissection, there will always remain some degree of doubt in the surgeon's mind as to whether such radical methods are justified in all cases. Lane,7 in supporting prophylactic regional node dissection states that one possible exception is the "superficial" lesion confined to epidermis and junctional level. Allen and Spitz3 define the "superficial" type as also extending into the immediate sub-epidermis. The demonstration of the excellent prognosis in melanomas not invading beyond the sweat gland level despite their size, offers a most useful guide to the surgeon in deciding in which case prophylactic node dissection is justified. This group described here as Stage I and II is numerically significant, there being 39

such cases without clinically involved lymph nodes in a total of 63. It is therefore, hoped that such histological observation will provide the surgeon with more clearly defined indications when the question of proplylactic lymph node dissection is considered. There is a very strong argument favouring prophylactic lymph node dissection in Stage III cases since such a large proportion of them subsequently develop regional node metastases. The system of classification by depth was used by Lund and Ihnen,<sup>2</sup> the depth of invasion being graded as "superficial", "dermal" or "subcutaneous", and a correspondingly more severe prognosis shown to exist. In the present study the difference in prognosis for tumours extending deeper than the sweat glands was found insignificant. However, when considering prophylactic lymph node dissection, it is the depth of dermal invasion which is seemingly all important.

#### SUMMARY

Out of a total group of 162 cases of malignant melanoma admitted to a General Hospital between 1929 and 1958, a series of 92 was available with a detailed followup of at least five years. The well recognized improved prognosis associated with smaller primary lesions is demonstrated, but of more importance it was found that histological depth of dermal invasion offered a much more accurate guide to the occurrence of later regional node metastases, in cases treated by local excision alone. In cases where the melanoma did not extend beyond the sweat gland level, the incidence of metastases developing later, if not clinically recognizable at the time of local excision of the primary, was 7.7%. Thus, with the demonstration of the excellent prognosis in certain clearly defined lesions and the very poor prognosis in others (see Table VI), the place for prophylactic dissection is very much more clearly defined and justified.

In the absence of clinically demonstrable lymph node metastases, it is recommended that regional lymph node dissection be restricted to patients whose primary tunour shows microscopic dermal invasion to a depth beyond the sweat glands.

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#### RÉSUMÉ

Cet article est une critique des résultats obtenus l'Hôpital Général de Montréal dans le traitement des mélanomes cutanés; la thérapeutique généralement employée consistait en l'excision locale de la

lésion, l'évidement ganglionnaire correspondant n'étant pratiqué que lorsque les ganglions en question étaient envahis, cliniquement parlant. Récemment de nombreux auteurs ont proposé des méthodes beaucoup plus radicales. C'est donc avant tout dans un but de comparaison que la présente étude a été effectuée. Il faut tenir compte ici du fait que dans les cas qui entrent dans les statistiques présentées, une importante proportion avaient été adressés à l'hôpital après un traitement préliminaire incorrect, ce qui assombrit le pronostic.

Tous les cas de mélanome traités entre 1929 et 1958 ont été passés en revue, à l'exclusion des mélanomes orbitaires et conjonctivaux. Le total se chiffre à 162 mélanomes malins et de 11 mélanomes juvéniles. Il fut possible de retrouver l'histoire ultérieure de 92 malades. Une première conclusion qui s'impose d'emblée est que les récidives qui se sont produites après cinq ans ne constituent que 15% des cas. Les résultats dé-taillés de cette étude, concernant le siège de la lésion primaire, la répartition par sexes, la taille et la profondeur de la lésion, les généralisations ganglionnaires sont présentés sous forme de tableaux.

Dans l'ensemble, les facteurs importants dans l'établissement du pronostic sont la taille de la lésion initiale et surtout son extension en profondeur. En l'absence d'invasion ganglionnaire ré-gionale cliniquement constatable, les grandes dissections lymphatiques doivent être réservées aux cas où le derme est déjà infiltré par la lésion primaire.

# AMPUTATION FOR MELANOMA OF **EXTREMITIES®**

"The situation may exist wherein the primary malignant melanoma is situated in the skin at a remote site from the regional lymph nodes involved by metastasis; for example, in melanoma on the sole of the foot with metastases to the femoral and inguinal lymph nodes, or a melanoma occurring in the nail matrix of a finger with metastases in axillary lymph nodes. With such an enormous intervening distance between the primary melanoma and the metastases in regional nodes, it is not possible by any technical operative procedure to remove both the primary and metastatic foci with the dissection of all the intervening lymphatics between the two sites. In the dissemination of melanoma from foot to groin or hand to axilla, respectively, by way of the myriad of lymphatic vessels and their sluggish circulation, the accidental lodgment of the melanoma cells anywhere en route inevitably would lead to local recurrence in the leg or arm. This complication has occurred frequently, for example, in patients having an amputation of a toe with groin dissection, with metastases occurring subsequently and diffusely in the skin and subcutaneous tissues of the intervening leg. Although the patient and his physician might consent immediately to such a radical operation as hip joint disarticulation for a bone sarcoma of the femur, it has been difficult to secure consent for this operation in the case of a small 'black cancer' on the ankle with metastases to femoral lymph nodes, and yet the disease is as fatal as other types of cancer that present more frightening aspects. There have been, however, a few cases in our experience in which the discontinuous operation of amputation of a digit or excision and skin grafting for a melanoma of the hand or foot with independent axillary or groin dissection has resulted in five-year definitive cures. Nevertheless, the number of these patients is so few in comparison with the large group of failures that one is reluctant to advise such conservative procedures except in aged subjects. . . . "

PACK, G. T.: End results in the treatment of malignant melanoma, Surgery, 46: 451, 1959.

# DRY ICE REFRIGERATION OF GANGRENOUS LIMBS

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Refrigeration of gangrenous extremities is not a new idea. It has been employed to provide local anæsthesia for amputation, and also to postpone the necessity for amputation until the patient's condition is improved and the operation can safely be carried out. Below 4° C. conduction in nerve ceases, and the toxicity of moist gangrene is lessened by slowing down the rate of decomposition and decreasing blood flow in the limb. Reaching this low temperature using ordinary ice is quite difficult as the ice usually melts before the limb attains the required temperature, and in melting, water generally floods the bed, making nursing procedures complicated. There has thus been considerable reluctance to employ the method even though its principle is sound. It was felt that refrigeration achieved without employing ordinary ice would have value in many situations. In elderly patients in particular, and in cases of multiple injuries where viability of a limb cannot be restored and amputation is impossible, temporizing might ensure the patient's survival. The dose of narcotics required for control of pain in older patients often has to be considerable, and may of itself contribute to the patient's poor condition by respiratory depression. Relief of pain in another way therefore is important.

Dry ice was first used in the Vancouver General Hospital 18 months ago, and it seems to be the ideal refrigerant for this purpose. With its sublimation point of -78° C. refrigeration of the limb is rapidly secured and can be maintained easily at a temperature well below 0° C. Evaporation causes no moisture, and the carbon dioxide vapour does not produce any ill effect. Nursing care of the extremity is reduced and the relief of pain has been dramatic. There is however, one fundamental point which must not be forgotten: anything so frozen is dead beyond recall.

The limb must be amputated eventually. The method cannot be used for refrigeration anæsthesia, with amputation through

the refrigerated area, as amputation must be proximal to this through viable tissue

# Indications

1. Postponement of amputation until the patient's general condition has improved. These patients are in two categories: (a) the old patient with a recent arterial occlusion not amenable to surgery and who is in cardiac and respiratory decompensation, and (b) the patient with multiple injuries who is unfit for amputation, and who suffers from an inoperable arterial injury producing gangrene of an extremity.

2. Prevention of the necessity for amputation in a moribund patient. These patients require only control of pain and of putrefaction of the limb.

# Technique

The method described below has proved satisfactory, but in fact almost any method of application will succeed provided that the dry ice is not allowed to escape into the bed, that it is properly insulated from the other limb, and that it is not applied above the gangrenous area.

# Materials Required (Fig. 1)

- 1. Dry ice.
- 2. Orthopædic stockinette.
- 3. Orthopædic wadding bandages.
- 4. Absorbent cotton.
- 5. Polyethylene bags, #12 size.
- 6. Quilted maternity pad.
- 7. Waterproof sheet.
- 8. Household gloves.

The dry ice has been obtained in this hospital from the ice cream supplier, who charges six cents per pound. It should be obtained in 25 lb. blocks and sliced into manageable pieces. It is almost impossible to break up the solid blocks. Dry ice will keep in an ordinary refrigerator wrapped in newspaper, and placed in a corrugated paper box, for about seven days, and this quantity is sufficient to freeze a limb for this period. Gloves are required for handling it. Matern ity pads have proved to be just the right size for the outer layer of insulation, but blankets are also satisfactory.

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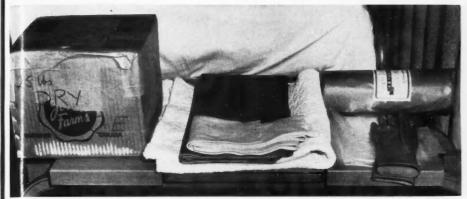


Fig. 1.—Materials required for dry ice refrigeration. Sliced blocks of dry ice, orthopædic stockinette and wadding, waterproof sheet, quilted maternity pad, absorbent cotton, rubber gloves, polyethylene bags #12 size.

#### Метнор

In gangrene affecting the distal leg and foot, such as shown in Fig. 2, the orthopædic stockinette is rolled onto the limb so that it extends from beyond the toes to midway up the thigh (Fig. 3). Slices of dry ice are broken up into smaller pieces and placed in polyethylene bags, which are loosely closed by folding over the ends. These are placed around the leg and foot, as high as the limit of the gangrenous area, about four to six bags being needed (Fig. 4). The leg and foot surrounded by bags are now wrapped in absorbent cotton, which is held in place with orthopædic wadding. The upper end of the stockinette is turned down over the absorbent cotton and wadding to prevent any dry ice from escaping at the knee (Fig. 5). The whole leg is wrapped up in a waterproof sheet, and this, in turn, is enclosed in a maternity pad, and held in place with safety pins or bandages (Fig. 6). Once dry ice has been applied in this way it will last for 24 to 48 hours. After evaporation, bags have to be refilled, replaced, and absorbent cotton wadding, waterproof sheet and maternity pad reapplied. Care must be taken to see that no dry ice escapes into the bed, and that it does not work its way up the limb beyond the gangrenous area. We have kept limbs refrigerated in this way for as long as three weeks.

As has been said the relief of pain is most dramatic and the requirements for

narcotics reduced. Improvement in the patient's general condition is of course not only due to refrigeration and reduction of toxicity, but also to the time allowed for correction of the concomitant cardiac and respiratory failure and other unfavourable conditions. When the patient is considered fit for operation the limb is amputated through normal tissue above the level of the refrigerated gangrenous part, under general anæsthesia. Entirely satisfactory healing has followed, proximal to the well formed line of demarcation.

#### CASE REPORTS

Case 1.—After falling out of bed in his home an 88 year old man noticed that his left leg was cold, mottled purple, the toes black and the veins distended. No pulses were palpable below the femoral which was reduced in amplitude compared with the right side. His general condition was poor. On physical examination Cheyne-Stokes respiration was noted; his heart was enlarged and fibrillating, and liver and spleen were palpable. He was incontinent. The left leg was packed in dry ice, and with medical treatment he improved so much that 16 days later the limb was amputated above the knee through healthy tissue, under spinal anæsthesia. Two weeks later the stump was well healed and the patient was discharged.

Case 2.—This 64 year old man was struck while drunk, by an automobile. He sustained a fracture of the pelvis and a rupture of the bladder. He was admitted to another hospital



Fig. 2.-Right leg prior to refrigeration.

where the bladder rupture was repaired and a suprapubic cystotomy carried out. His right leg was cold and blue. Six days later he developed anuria and was transferred to the Vancouver General Hospital for treatment of this complication. On admission he was oliguric, the right leg and foot were gangrenous, the thigh swollen and mottled blue. No pulses were palpable in the extremity. There were fractures of the pelvis and ribs. Non Protein Nitrogen was 270 mg.%. It was decided to pack the gangrenous leg in dry ice and dialyze the patient with the artificial kidney. This

was done on two occasions before renal function returned. During this time he survived a staphylococcal septicæmia and his condition gradually improved. He required minimal sedation as the limb was free of pain. After 15 days of refrigeration it was felt that his leg should be amputated as his NPN had risen further (the source of nitrogenous products was thought to be the gangrenous leg). Pathological report on the surgical specimen remarked on the absence of infection though no cultures were taken. The patient died three days later; at post-mortem he was found to



Fig. 3.-Stockinette applied.

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Fig. 4.-Dry ice in polyethylene bags, laid along leg to upper level of gangrene.

have a rupture of the liver, with subphrenic abscess, bronchopneumonia, and extensive hæmatomata of the buttocks, flanks and upper thighs. It is doubtful whether the source of the rise in NPN was in fact the gangrenous leg.

Case 3.-A 75 year old woman developed gangrene of the right leg and foot the day before admission to hospital. The cause was thought to be an embolus from the left heart

as fibrillation was noted on examination. Her condition was so poor that amputation was not possible, although pain from the limb was severe. The leg was packed in dry ice and pain was immediately relieved. Her condition continued to be poor and she died four days later. During this time nursing was no problem and sedation requirements were minimal.

# DISCUSSION

Five additional patients have been



Fig. 5.—Absorbent cotton wrapped around the dry ice and leg, held in place with orthopædic wadding, and the upper end of the stockinette folded down to prevent dry ice escaping.

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Fig. 6.—The final layers of waterproof sheet and quilted maternity pad applied and held in place with bandages.

treated. Of these, two came to amputation, and one died three days later. One patient with multiple injuries died the day following refrigeration of the limb. The other two patients were moribund, and treated solely for relief of pain. In all these cases, relief of pain was gratifying, and nursing care undoubtedly made easier. In none could any deleterious effect be detected.

It has always been difficult to know how to care for old patients who develop gangrene as a further step in the inexorable course of their cardiovascular disease. Some may live happily for some time following amputation, others are moribund, but amputation becomes necessary for humanitarian reasons. Dry ice refrigeration has enabled us to spare the moribund an unnecessary operation yet ease their demise, and to postpone a necessary amputation for the others until they are better able to withstand it. The nursing staff have welcomed the method as a way of simplifying the care of these patients, and in practice, its application has been simple and economical.

#### SUMMARY

- 1. The refrigeration of gangrenous extremities with dry ice is described.
- 2. Indications are: (i) To enable amputation to be postponed until the patient can

tolerate the operation. (ii) To obviate amputation in moribund patients by relieving pain and simplifying nursing care.

3. Illustrative cases are reviewed.

#### RÉSUMÉ

La réfrigération d'une extrémité gangréneuse n'est pas une technique nouvelle. On l'emploie pour établir une anesthésie locale en vue de l'amputation ou pour permettre une amélioration de l'état général du malade pour le rendre capable de supporter une amputation. A une température de 4° C., la conduction nerveuse cesse et l'intoxication gangréneuse est grandement diminuée du fait que l'apport sanguin dans le membre atteint est alors très réduit. L'utilisation de la glace pour obtenir cet abaissement de température se révèle peu pratique: la glace ordinaire fond bien avant que le membre ne soit porté à 4° C. et l'inondation du lit est fréquente, ce qui complique considérablement le travail des garde-malades.

C'est pourquoi on a tenté d'employer, à l'hôpital Général de Vancouver, la neige carbonique (dry ice); la réfrigération du membre est rapidement atteinte et la sublimation du produit ne comporte que des vapeurs de gaz carbonique faciles à évacuer. Il faut cependant se souvenir que la température peut souvent être abaissée en dessous de 0° C., et que les tissus ainsi gelés sont morts. Pour l'emploi, les blocs de glace carbonique sont cassés en petits morceaux et placés dans des sacs de polyéthylène; ces sacs sont posés au contact du membre malade, lui-même protégé par un bandage. Le tout est enveloppé de couvertures.

A titre d'exemples, trois cas traités selon cette méthode sont alors présentés: il s'agit de gargènes du membre inférieur spontanées ou traimatiques. Le soulagement de la douleur fut to i-jours spectaculaire ainsi que le relèvement le l'état général.

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# A METHOD OF MANAGEMENT OF DISPLACED FRACTURES OF THE SURGICAL NECK OF THE HUMERUS

I. A. D. TODD, M.A., M.B., B.Chir., and J. E. MULLENS, M.D., F.R.C.S.[C], Toronto

Most fractures of the surgical neck of the humerus in adults may be managed by the use of simple support and early movement. In a small percentage, however, gross displacement necessitates reduction and this must be maintained by some fixation other than bandages. We report here a simple method of reduction and immobilization with which we have had some success.

# THE DISPLACED FRACTURE OF THE SURGICAL NECK

Many classifications are proposed for fractures of the surgical neck of the humerus, the merits of which we need not debate here. 1-3, 11, 12 Common to these is the type of fracture in which the distal fragment is markedly displaced in relation to the proximal fragment, with significant associated angulation (Fig. 1). Many methods of management have been suggested for these fractures. Where reduc-

tion is difficult to obtain or maintain, some advocate open reduction and fixation by means of suture,4 screw, pin and plate, or multiple intramedullary wires. 6, 18 Others advise the use of an abduction frame,7-9 spica,10,11 or hanging cast,4,6,12 once reduction has been achieved. Still others are in favour of accepting gross displacement, at least in the elderly, and treating the patient by simple support and early movement.2, 9, 12-15 We feel that some of these methods are too radical, some desperate, and others cumbersome. We no longer use the abduction splint and spica, and have not found it necessary to perform open reduction in our small group of cases.

#### METHOD OF MANAGEMENT

In 1950 and again in 1958 Saha reported his studies on muscular action about the shoulder joint.<sup>16, 17</sup> By electromyography he was able to show that the neutral or "zero" position of the head of the humerus

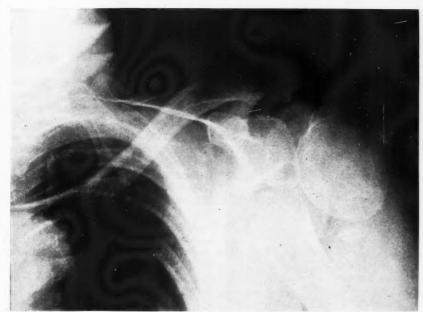


Fig. 1.-Displaced fracture of surgical neck of the humerus.

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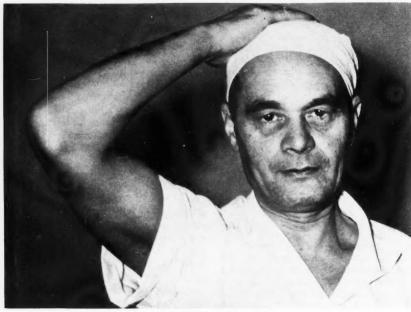


Fig. 2.-The "zero" position.



Fig. 3.-Site of introduction of Kirschner wire.

in the glenoid fossa was attained when the arm was abducted to 165° and brought forward 45° toward the sagittal plane. Placing one's hand on the vertex of one's head is the simplest illustration of this position (Fig. 2). It followed then that the proximal fragment of an unstable fracture of the surgical neck would assume this position if allowed to do so, and in order to achieve reduction, the distal fragment need only be brought into line with the proximal. We have successfully adopted this method of reduction and can attest to its usefulness.

When the fracture has been reduced it may be secured by the method described by Murray<sup>18</sup> in 1945. With the patient under general anæsthesia, reduction is performed and the arm is brought carefully down into the adducted position until it is possible to insert a Kirschner wire through a stab wound in the skin and into the greater tuberosity of the humerus (Fig. 3). The wire is first directed toward the axilla, and when it is judged to be well into the proximal fragment its direction is changed toward the elbow. In this manner it crosses the fracture line, without

the fracture being exposed surgically, and is driven distally until it impinges on the inner cortex of the humerus just above the elbow. The end of the wire is then cut off below the skin surface at the shoulder and the patient's arm held to the side by a Velpeau bandage. The puncture wound in the skin of the shoulder is covered with a sterile dressing. On occasion we have used two or more wires considering that we might thus improve fix tion, but have found that one stout wife is usually sufficient to maintain an acceptable reduction (Figs. 4 and 5).

Guarded shoulder movements are begun ten days later when the bandage or sling has been removed, and the Kirschner wire is removed under local anæsthesia in three to give weeks.

# THE SERIES

From January 1954 to January 1959 we have used this method of management in 14 displaced and unstable fractures of the surgical neck of the humerus at the Wellesley Hospital. The ages of the 14 patients in this series ranged from 17 to 93 years. There were two deaths both of which were in decrepit women over 80 years of age who succumbed to congestive heart failure before leaving hospital.

A follow-up was carried out on the other 12 patients and all but one have excellent results. We regard an excellent result as one in which the patient has no disability whatsoever in the affected shoulder when compared to the opposite side.

The average time of complete recovery of the shoulder was six months. During the same period 37 other patients were admitted to hospital with fractures of the surgical neck of the humerus for treatment by other methods such as sling and swathe, or abduction spica. We were able to examine or obtain information on 34 of these patients and found that seldom was return of full function accomplished before one year. Outpatients were not included in this study.

#### DISCUSSION

It is generally agreed that displaced and unstable fractures of the surgical neck of



Fig. 4.—A reduced fracture of surgical neck with Kirschner wire fixation.

the humerus in young patients should be reduced and adequate position maintained in order to obtain better function. We feel that this principle should be extended to include selected aged patients provided that the method of management does not increase the morbidity and mortality. Indeed, it may be argued that accurate reduction in the elderly is even more desirable as the aged patient is less able to rehabilitate his shoulder, and is, therefore, more likely to have a better result if reduction is accurate. The average elderly patient with this fracture tolerates short anæsthesia well, and may be treated by the method here described. The fact that two of our patients died suggests that we might have been more stringent in our selection of patients for this procedure, or perhaps better advised to use local anæsthesia. One of these patients had a compound fracture, however, and general anæsthesia was considered advisable. Howard and Eloesser19

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Fig. 5.-Lateral union of fracture shown in Fig. 4.

are of the opinion that local anæsthesia is all that is required in most circumstances.

Introduction of the wire by this technique requires a little experience to be proficient, but once learned it can be performed quickly. We have also found it of use in the management of some fractures of the shaft of the humerus, and have treated seven such fractures by this method.

We favour the removal of the wire three weeks after its introduction. Projection of the wire under the acromion might otherwise interfere with the early mobilization of the shoulder as witnessed by one of our patients who has refused to have the wire removed and has poor function of her shoulder. She is the only patient who has had a bad result.

# Conclusions

- 1. The "zero" position described by Saha is a satisfactory method of reducing lisplaced fractures of the surgical necl of the humerus.
- 2. Maintenance of reduction may be secured by the introduction of one or n ore Kirschner wires across the fracture site by a closed technique.
- 3. We have found the results of treatment by this method superior to o her methods.

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#### RÉSUMÉ

La majorité des fractures du col chirurgical de l'humérus chez l'adulte peuvent être traitées par un simple support et la mobilisation précoce. Da 1s certains cas, cependant, l'importance du dé<sub>!</sub> lacement nécessite une fixation autre qu'un simple bandage. Les auteurs présentent ici une méthode de réduction et d'immobilisation qui leur a donné de bons résultats.

Ils ont surtout en vue les fractures dans lesquelles les fragments sont à la fois déplacés et angulés. Ils font état du fait que la position "zéro" de la tête humérale (c'est à dire celle où cette tête ne se trouve soumise à aucun effort musculaire) est atteinte dans l'abduction à 165° et la rotation antérieure du bras à 45°. Dans une telle position (que l'on obtient en plaçant la main sur le vertex) la réduction se fait facilement par alignement du fragment distal sur le fragment proximal. La contention est assurée par passage d'une, ou si besoin est, de plusieurs broches de Kirschner à travers le foyer de fracture; l'introduction s'en fera en partant de la grande tubérosité humérale, en visant le coude.

Sur une série de 14 patients traités ainsi, les résultats furent excellents dans 12 cas. L'intervention peut se faire sous anesthésie locale ou générale, selon l'état du malade.

#### EXPERIMENTAL SURGERY°

"Experimental surgery has advanced from a laboratory evaluation of operative procedures to a wider area of investigation involving many subjects hitherto considered beyond the scope of the surgeon. It is not a specialty by itself, but covers a field of research related to surgery and of interest to surgeons. Its field includes such diverse subjects as oncology, neurochemistry, endocrinology, angiology, and muscle physiology in addition to studies of general phenomena of infection, shock, metabolic response to injury, and neoplasia. On the solid foundation of the fact that research in surgery is not only desirable but necessary, one can consider its objectives as follows.

"The most important task is probably the widening of the scientific approach in surgery. New facts and data related to surgical practice are uncovered continuously by research in basic sciences. It is up to the surgeons to evaluate the applicability of these findings to surgery. Not only have new fields for surgery opened recently, but also the approach to many surgical problems has undergone a change as a result of better understanding of the basic principles involved.

"The clinical experience in surgery provides

a unique opportunity for observations in investigation of basic phenomena in many fields such as cancer research, exposure to traumatic and infectious agents, shock, and so forth. The contribution of a surgeon to research progress in these fields can be considerable, since facts, simple and obvious to him from clinical practice, might appear to others just as obscure as some physical chemistry is to surgeons.

"The final objective, but not the least important, is the training of the young generation of surgeons in research. It is unlikely that a year of investigative work prescribed by most medical schools as part of a graduate training program will lead to startling experimental findings, although notable exceptions have been made. It is the contact of the future surgeon with experimental methods which is of primary value in addition to the recognized importance of research in teaching. The preparation of the mind to face research problems of the future appears to be the logical answer to the ever increasing scope of surgery.

"While the Art of Surgery seems to have reached the summit, the Science of Surgery is confronted with a new world of electronics, sputniks, and biophysics. Whether we can keep in step with these developments depends. largely on progress in surgical research."

<sup>°</sup>SKORYNA, S. C.: Surgery, 46: 1162, 1959.

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# IMPERFORATE ANUS WITH RECTOVAGINAL FISTULA IN AN ADULT°

P. H. NILOFF, M.D., F.R.C.S.[C], M. M. GELFAND, M.D., F.R.C.S.[C] and G. J. STREAN, M.D., F.R.C.S.[C], Montreal

Cases of imperforate and with rectovaginal fistula persisting into adult life although not rare, are relatively uncommon, and thus few surgeons have opportunity to develop a significant personal experience in their management. Even though some patients, including the one case reported here, are able to control their bowels fairly well, the disadvantage at coitus makes repair desirable.

The reported incidence of imperforate anus varies from one in 5000 to one in 10,000 live births. Additional developmental anomalies are frequent and are found in from 28% to 68.7% in reported series. 1, 7, 9, 10, 13-15, 18 These anomalies involve most frequently the genitourinary system. The case reported here had the added anomaly of crossed ectopia of the right kidney with fusion and absence of the left ureter.

The embryology of this anomaly has been described in detail by many authors1, 4-8, 12-14, 16 with the concept of ectopic rectal opening rather than imperforate anus being recently advanced by Bill.2, 3 developmental The important changes occur between the third and eighth week of embryonic life. In the third week the bladder and hindgut empty into a common cavity, the cloaca. In the sixth week a downgrowth of mesoderm appears so that by the seventh week the urogenital and intestinal systems have been separated. Any arrest of this downward growth will result in communicating fistulas. In a woman, the müllerian ducts, the lower portion of which forms the uterus and vagina, descend in the urogenital septum and partake in any fistulous communication which may be present. In the eighth week, the urogenital and anal membranes break down to establish external openings. Failure of the anal membrane to break down results in an imperforate anus, or stenesis if incomplete. Since the anal sphincter is derived from mesenchyme and is in lependent in development from the ectodermal and endodermal origins of the anus and rectum, these patients possess an anal sphincter. The concept proposed by Bill2, 3 is that the so-called "imperforate anus" is actually an ectopic rectal opening, and that some communication from the tip of the rectum is present although this may be very small. In describing the embryology he suggests that the opening of the fetal rectum into the cloaca moves ahead of the developing urogenital septum till the rectal opening reaches the perineum. It then gradually moves backward till the normal position of the anus is reached. It is his impression that this migration of the tip of the rectum may stop at any point along its course and that this would account for abnormally located rectal openings.

The classification of these anorectal anomalies proposed by Ladd and Gross<sup>13</sup> has been most widely accepted (Fig. 1). Of the above described anomalies, type 3 are the most common.<sup>19</sup> Although high rectovaginal fistulas do occur, most of the tracts open into the fourchette.<sup>11, 19</sup> In the present case, the fistula opened into the lower third of the vagina.

#### CASE REPORT

A 32 year old unmarried woman was admitted to the Jewish General Hospital, Montreal, in 1958, with a history of imperforate anus and rectovaginal fistula. She knew that this condition had been present since birth but had been told that nothing could be done about it. She now wished to marry and hoped that something could be done to correct this infirmity. Family history revealed both parents to be alive and well. The patient's mother experienced no difficulty during pregnancy, nor did she receive any radiotherapy at that time. Past history revealed three previous hosp tal admissions. In 1942 the patient was hospitalized for removal of ovarian cysts. In 1945 an

<sup>\*</sup>From the Departments of Surgery and Gynæcology, Jewish General Hospital, Montreal Quebec. Presented at the annual meeting of the Royal College of Physicians and Surgeons of Canada, Vancouver, B.C., January 1959.

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appendectomy was performed, and in 1947 she had radiotherapy for menorrhagia. She had not menstruated since. The was functional enquiry otherwise negative. General physical condition was normal. Pelvic examination revealed a rectovaginal fistula in the lower third of the vagina. The vagina above the fistula admitted one finger. The cervix was small, fixed anteriorly, and the adnexal regions were normal. She could use her levator muscles as a veritable sphincter to close the vagina completely. Intravenous pyelogram showed a crossed ectopia of the right kidney with fusion and absence of the left ureter.

The patient was prepared for operation with oral neomycin, cleansing enemata and vaginal packing with sulfathiazole cream. She was operated upon under general anæsthesia in lithotomy position with a Foley catheter in the bladder.

Procaine hydrochloride was injected between the fistula and posterior vaginal wall to facilitate dissection. A circular in-

cision was made around the lumen of the fistula and the fistula was dissected from the posterior vaginal wall up to the fornix. The fistula and rectal pouch were then mobilized laterally and posteriorly. The major portion of the dissection was done bluntly and care was taken to preserve blood supply to the future rectum. A transverse skin incision made at the dimple revealed a definite sphincter muscle. An opening was then made through the sphincter and between the levator muscles by blunt dissection with a Kelly forceps. The rectal pouch with the fistula was then brought through the opening without tension. The mucosa was sutured to the perianal region in two layers with intestinal chromic catgut; one layer suturing the muscularis to the subcutaneous tissues and the other layer suturing the mucosa to the perianal skin. The terminal portion of the mucosa was incised

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Fig. 1.—Types of malformations of the anus and rectum. (1) Stenosi at the anus or lower rectum. (2) Membranous form of imperforate anus. (3 Anus is imperforate and fistulas are present. Rectovaginal fistula is shown (4) The anal canal and lower rectum form a blind pouch, and this is separated from the rectal pouch.

and bled, indicating a good blood supply. This newly formed anus admitted two fingers and good sphincter tone was felt. The area of the fistula was then repaired by approximating the levator muscles over the xectum and suturing the vaginal mucosa. The vagina admitted two fingers. A two-inch gauze pack was left in the vagina.

Postoperatively, the patient was placed on a low residue diet for 48 hours. The bowels moved on the third postoperative day. The anus and vagina healed uneventfully. The patient was discharged 14 days after operation, and at that time she was continent and was able to contract the anal sphincter. She was somewhat constipated. She was advised to dilate the anus digitally while at home as a precaution against stricture during the healing phase.

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Fig. 2.—Preoperative photograph of the introitus. Note absence of the anus and suggestion of anal dimple.

When re-examined after six months, the anus was well healed and the patient's only complaint was mild constipation, which was readily controlled by laxatives.

The operative procedure described above was relatively simple and gave a most satisfactory result. The most favourable time for surgical repair of this anomaly varies with different authors. In the cases reported by Santulli,19 the age varied from five days to 28 years, and he did not reach any definite conclusion as to the ideal age for elective repair. He adopted the policy of repairing the anomaly at any age if it was complicated by a fistula too small for adequate evacuation, repeated episodes of fæcal impaction and repeated urinary infections. He felt that treatment in each case should be individualized. However, patients who did not develop complications were treated by elective procedures between the third and twelfth years. Browne<sup>4</sup> suggested the preferred age for elective repair to be between five and seven years. Those who have a fistula of adequate size may not seek medical attention until a relatively late period. In the case presently reported matrimonial intentions prompted medical attention. The fact that the patient was 32 years old did not appear to be an unfavourable factor. Harken<sup>11</sup> suggested that delay in operative correction for several years might predispose to a lesser degree of continence due to disuse atrophy of the sphincter muscles; however, in the above case the external sphincter muscles appeared well developed. Complete preservation of the sphincter renders complete



Fig. 3.



Fig. 4.

Figs. 3 and 4.—Photographs taken after six months.

continence more likely; 15, 17 this is readily accomplished by gentle dissection through the centre of the external sphincter without division of the muscle. The result in the above case supports the recommendation of those who suggest that a small orifice which can be dilated, is more likely to give

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satisfactory result than a large patulous orifice.17

#### SUMMARY

Cases of imperforate anus with rectovazinal fistula persisting into adult life, while not rare, are uncommon. Although some patients, including the one reported here, are able to control their bowels fairly well, the disadvantage of such a fistula at co tus makes repair desirable.

The embryology of this anomaly is described briefly with special reference to the factors influencing surgical repair.

A case of imperforate anus with rectovaginal fistula in a 32 year old woman is discussed in detail. In addition to this anomaly, there was present an ectopia of the right kidney with absence of the left ureter. Reconstruction of the imperforate anus and closure of the rectovaginal fistula were performed by the perineal approach. The rectal pouch and fistula were separated from adjacent tissues through an incision in the posterior vaginal wall and the rectum was exteriorized at the anal skin dimple in the perineum. The rectum was brought through fibres of the external anal sphincter. The patient had an uneventful convalescence and obtained good functional and cosmetic result. The relative simplicity of this operative procedure with its most satisfactory result is emphasized.

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#### RÉSUMÉ

Les cas d'anus imperforé avec fistule rectovaginale persistant jusqu'à l'âge adulte sont rares en général. Quoique certains malades, dont celle que nous présentons, peuvent obtenir une bonne continence fécale, le désavantage que présente une telle fistule pendant le coït rend sa réparation désirable. L'embryologie de cette anomalie est brièvement décrite et mention est faite des conditions qui peuvent faciliter sa réparation chirurgicale. Un cas d'anus imperforé avec fistule recto-vaginale chez une femme de 32 ans est décrit en détail. En plus de cette anomalie on a découvert une ectopie du rein droit avec absence de l'uretère gauche. La reconstitution de l'anus imperforé et la fermeture de la fistule recto-vaginale ont été pratiquées par voie périnéale. L'extrémité rectale et la fistule furent séparées du tissu sousjacent par une incision dans la paroi postérieure du vagin. Le rectum fut extériorisé au niveau de la dépression anale dans le périnée. On le fit ensuite descendre à travers les fibres musculaires du sphincter anal externe. Les suites furent banales et la malade a obtenu un bon résultat fonctionnel et cosmétique. Nous désirons souligner la simplicité relative de ce procédé et les résultats satisfaisants qu'il procure. P.H.N.

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# STRANGULATION OF THE APPENDIX EPIPLOICA: A SERIES OF 11 CASES°

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STRANGULATION of an appendix epiploica is generally considered to be an extremely rare cause of an acute abdomen. Up to December 1958, only 108 cases were reported in the world's literature; 99 within the abdomen and nine within hernial sacs. The condition probably occurs more commonly but is not recognized and treated. Spontaneous resolution occurs commonly but four deaths directly attributable to this cause have been reported.

In this paper, 11 cases of the condition are presented; these have been encountered at the Vancouver General Hospital and St. Paul's Hospital, Vancouver, B.C. over the past four years. It is hoped to illustrate by these cases that this disease is more than a clinical oddity, that it may easily be overlooked, and that it can cause significant morbidity. Cases of torsion of an appendix epiploica within a hernial sac have not been included in this series, although examples can be found in the hospital records, including one in a two month old infant with a femoral hernia.

The cardinal symptom is localized pain in the absence of severe illness. There are, unfortunately, no features which will differentiate it from other more common and more severe surgical abdominal diseases. Therefore, it is not a disease which can be diagnosed safely preoperatively. Most commonly it simulates acute inflammation of the vermiform appendix. Clearly, the significance to a surgeon lies not in diagnosing the condition preoperatively, but in being aware of it so that it will not be overlooked at laparotomy. In five of the 11 cases reported here, the pathology was not recognized or understood at operation although it was dealt with intuitively. Symptoms may be intermittent or chronic, so that failure to deal with the pathology may leave the patient with persisting distress.

There have been a number of excellent reviews of diseased appendices epiploicæ in the recent literature. Each author who has reviewed the literature has analyzed cases seen in the past, and added some of his own experience. Wakeley and Childs1 reviewed 64 cases which have appeared up to 1949 and added eight additional cases. Rosenbaum and Kissinger<sup>2</sup> reviewed 79 previous cases in 1950 and added three of their own. In 1953 Saltz and Saypol3 reviewed 94 previous cases with two additions and Fieber and Forman4 analyzed 105 previous cases with three additions. It is not our purpose to review the literature further. Rather, we wish to point out some of the outstanding clinical features of previously reported cases, adding 11 new cases which help to illustrate some of these features.

The appendices epiploicæ are small, fatcontaining sacs of peritoneum which may vary from a few millimeters to several centimeters in length. There may be 100 or more arranged along the colon, usually in a double row bearing a close relationship to the tæniæ. One row is situated medial to the anterior tænia and the other lateral to the postero-lateral tænia. It is generally agreed that they are larger in obese persons and this disease is certainly more common in such people. The function of these organs is not known. It has been variously suggested that they serve as protective buffers for vessels when the bowel becomes distended, that they act as cushions for the bowel, and that they help protect against infection. Whatever their true function may be, it is the blood supply to them which is of significance in disease. Pines et al.5 have described their blood supply in detail. The colonic vessels divide and encircle the bowel before entering the appendices epiploicæ. The main vessel enters the bowel wall adjacent to the tæniæ and continues into the epiploic appendage forming a U-shaped are from which branches are given off to the fat of the appendage and to the bowel wall. Of the appendices epiploicæ which become involved in disease, 69% are in the sigmoid colon, 25% in the cæcum, and 15% are

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distributed through the rest of the large bowel. Disease usually starts from torsion of the pedicle, although thrombosis subsequent to infection has been reported. Compromise of the blood supply leads eventually to infarction and gangrene. Presumably the process can then go on to hyalinization, calcareous degeneration and finally disengagement of the appendage so that it becomes a loose body in the peritoneal cavity. Such loose bodies are described as "corpora ariena adiposa". Judging from the symptoms encountered in the following cases, this process may have a widely varying time sequence.

Case 1.—Mr. T.N., aged 25 years, was admitted to the Vancouver General Hospital, complaining of a steady and annoying pain of 27 hours' duration, localized in the right lower quadrant of the abdomen and aggravated by movement. There had been no digestive upset. Although the pain was definitely aggravated by any jarring, it was not severe enough to limit his activities completely.

On physical examination, he was found to be a healthy young man, moderately obese, and in no great distress. His temperature was 98° F., blood pressure 110/75 mm. Hg, pulse 78 and regular. His abdomen was flat, and there were good bowel sounds. There was some guarding to palpation of the right side of the abdomen with decided tenderness over McBurney's point. There was no definite rebound tenderness, but any movement of the abdomen resulted in pain, localized to McBurney's point. Rectal examination revealed a normal prostate with marked tenderness above and to the right.

Hæmoglobin was 16.1 g. %, white blood count (WBC) 10,000/c.mm., 65% polymorphs and 3% staff cells, and his urine had a slight trace of protein. A preoperative diagnosis of acute appendicitis was made.

At operation through a McBurney incision, turbid serosanguinous fluid was noted in the peritoneal cavity. The appendix appeared normal. The terminal ileum was delivered in a search for evidence of ileitis or mesenteric glands. Further exploration of the peri-cæcal region revealed a two cm. infarcted appendix epiploica, twisted on a very narrow pedicle, which was removed. There was marked inflammation of the adjacent colon. The appendix which appeared normal, was then removed.

Pathological report was that of an infarcted appendix epiploica, and a normal appendix.

Case 2.—Two days before admission Mrs. M.L., aged 45, had developed crampy right abdominal pain with the onset of her menses but there had been no vomiting, anorexia, nausea, diarrhœa, or temperature elevation. Positive findings were limited to the abdomen. There was tenderness over the right lower quadrant, with marked rebound tenderness and questionable splinting. Rectal and pelvic examination showed some tenderness on movement of the cervix, but this was not remarkable.

Laboratory work showed a WBC of 6,150/c.mm. with 76% polymorphs. Her urine was clear.

At operation the appendix was found to be relatively normal, but further examination revealed about two cupfuls of serosanguinous fluid in the pelvis. The pelvic organs and small bowel were normal. A mass about 1.5 inches in diameter was found in the mesentery of the transverse colon and was shelled out. It was thought to be a thrombus.

Pathological examination showed an unremarkable appendix. The supposed blood clot turned out to be an appendix epiploica which had become infarcted.

Case 3.—Miss J. D., a 33 year old woman, complained of pains in the right lower quadrant of three days' duration, accompanied by some nausea without vomiting. This was her third attack of this nature but otherwise she had no complaints.

Physical examination was normal, except for the abdomen where there was definite localized tenderness over McBurney's point, with rebound tenderness. Rectal examination was negative.

Her total WBC was 10,200/c.mm. with 37% polymorphs. A preoperative diagnosis of acute appendicitis was made and laparotomy performed.

The abdomen was opened through a right paramedian incision. On opening the peritoneum, a small amount of murky fluid appeared from which was cultured a light growth of Staphylococcus albus. The appendix was removed and further examination of the abdomen revealed a hard nodule over the sigmoid colon which was hæmorrhagic and firm. The nature of this structure, which was shelled out, was uncertain and it was sent to the laboratory.

Pathological examination showed a vermiform appendix which was normal, except for fibrous obliteration of the lumen at the tip. The hæmorrhagic nodule was an infarcted appendix epiploica. Case 4.—Mr. E.J., aged 23, complained of a dull aching, diffuse pain of two days' duration across the lower abdomen, with brief periods when a stabbing pain was superimposed. His appetite had been poor although he had had no nausea or vomiting.

Physical examination was normal except for the abdomen. There was tenderness without rigidity in the suprapubic and peri-umbilical regions, and tenderness and guarding in the right lower quadrant. Rectal examination was normal. His temperature was 99.4° F. and WBC 9500/c.mm. with 68% polymorphs and 5% staff cells. A preoperative diagnosis of acute appendicitis was made.

At operation a right paramedian incision was made. On opening the peritoneal cavity a small amount of blood-tinged serous fluid was aspirated. An infarcted appendix epiploica of the sigmoid colon, surrounded by omentum, was seen immediately. This and the vermiform appendix were removed.

Pathological examination showed an irregular fragment of fatty tissue which had undergone hæmorrhagic infarction. The appearance was consistent with an infarcted appendix epiploica. Multiple sections of the appendix showed the lumen to be dilated and filled with fæcal material, but there was no evidence of inflammation in the wall.

Case 5.—Mrs. I.Y., an obese woman 57 years of age, complained of loose bowels of three weeks' duration with mucus but no blood. Sigmoidoscopic examination revealed a normal rectum and sigmoid colon, but a barium enema showed a lesion in the sigmoid colon which was suspicious of a malignancy. Abdominal examination showed two old surgical scars but was otherwise normal. She had a long history of vague abdominal pains but repeated investigations including two barium enemas had been negative.

Her temperature was 99.4° F. and WBC 6,950/c.mm. with 57% polymorphs. Serum proteins were normal and the stool was negative for occult blood. A tentative preoperative diagnosis of carcinoma of the rectum was made.

At operation, a transverse incision was made below the umbilicus. Exploration showed some adhesions but the small intestine was normal. On the lateral side of the sigmoid colon, there was a nodule approximately 1.5 cm. in diameter, which was impinging on the wall of the colon. The nodule was resected and the abdomen closed.

Pathological examination revealed fragments of fatty and fibrous tissue, in which there were occasional small collections of lymphocytes. Diagnosis was cystic degene ation (infarction?) of an appendix epiploica

Case 6.—Mrs. H.E., aged 56 years, complained of a dull ache in her left lower qualifient of four months duration. She had been having approximately three bowel movements per day with a mucoid discharge, but no blood. Three years previously roentgenogram examination of her colon had been made reveling one polyp. A repeat roentgenogram new showed what appeared to be two polypi.

On physical examination, no masses were palpated in the abdomen. Sigmoidoscopy to five inches was normal. She was admitted to the Vancouver General Hospital for an exploratory laparotomy. A tentative preoperative diagnosis of carcinoma of the left colon was made.

At operation, the abdomen was opened through a left rectus incision. In the midsigmoid area a firm, reddish coloured appendix epiploica was seen which was removed. A small longitudinal incision was then made in the left colon and a sigmoidoscope introduced. A single polyp was identified and removed.

Pathological examination revealed a congested and mildly inflamed appendix epiploica. There was a benign adenomatous polyp of the sigmoid colon.

Case 7.—Mr. K.M., a 17 year old boy, was sent home from school in the morning complaining of a pain in the left lower quadrant of one days' duration.

Physical examination was negative except for the abdomen where there was tenderness without rigidity in the left lower quadrant plus marked tenderness over McBurney's point. He was observed for a time, but in the evening his pain became worse and he developed rigidity in the left lower quadrant with rebound tenderness in that area. There was also marked tenderness on the right side on rectal examination. His urine was clear, WBC 8200/c.mm. with 68% polymorphs.

A preoperative diagnosis of acute appendicitis was made. At operation, a paramedin incision was made and some red, hard tissue, having the appearance of a gland, was found on the ascending colon just above the appendix; both this tissue and the apparently normal appendix were removed.

Microscopic examination showed a normal vermiform appendix and a mass of inflammatory origin the histological picture of which was consistent with that of a twisted append x epiploica.

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Case 8.—Mrs. L.H., aged 46, was an obese woman who had been investigated in hospital one month prior to her admission for acute appendicitis. At the time of her first investigation she complained of crampy pain in the right lower quadrant of five days' duration with some anorexia but no vomiting. Investigation was negative except for tenderness in the right lower quadrant of the abdomen. She was sent home with a diagnosis of subsiding appendicitis. She was well until the day before readmission when a dull ache, which became sharp on movement developed in the right lo ver quadrant.

There was tenderness on palpation of the rith lower quadrant but no guarding. A preoperative diagnosis of chronic appendicitis was made. The urine was clear, WBC

6.00/c.mm. with 52% polymorphs.

At operation, a lower left paramedian incision was made. On opening the abdomen, a great mass of adhesions was discovered, presumably the result of a childhood tuberculous peritonitis, making it difficult to explore the entire gastrointestinal tract. A hæmorrhagic "gland" was found behind the cæcum and this was dissected out. No other abnormalities were found. The appendix was removed in routine fashion.

Microscopic examination showed a normal appendix. The tissue removed from the cæcum and sent over as a lymph node was a tag of necrotic fat in which there was considerable extravasation of blood. This was compatible with a strangulated and infarcted

appendix epiploica.

Case 9.—Two days before admission Mrs. J.B., aged 25, developed a bout of diarrhea with six to seven movements per day. A crampy pain began in the lower abdomen the day before admission. The patient had finished a normal menstrual period three days before her symptoms commenced. Physical examination was negative except for the abdomen which appeared to be distended, and there was pain on palpation of the lower part of the abdomen with fairly marked rebound tenderness. A pelvic examination was performed under anæsthesia three days after admission but there was no Hegar's sign.

A needle colpctomy produced thin watery pus with a little bit of blood. It was considered that she was suffering from acute salpingitis but she was unimproved after observation in hospital for one month. A repeat pelvic examination gave an impression of a soft mass on the left side of the uterus. The cervix was quite tender to movement. It was now thought

she had a hydrosalpinx, but the possibility of an ectopic pregnancy was kept in mind.

Operation was performed through a left paramedian incision. There were some old necrotic adhesions on the posterior wall of the uterus but there was no mass in the pelvis. On examining the sigmoid, a necrotic appendix epiploica was found and was removed.

Microscopic examination showed a circumscribed mass of fat in which there was hæmorrhagic extravasation, and degenerative changes along with scattered inflammatory cells. This was compatible with a diseased appendix

epiploica.

Case 10.—Mr. H.G., an obese man of 29 complained of stabbing, intermittent pains in the right lower quadrant of six months' duration. His appetite and bowel function were normal.

On examination the abdomen showed slight tenderness in the right lower quadrant without rigidity. A preoperative diagnosis of chronic

appendicitis was made.

At operation the abdomen was opened through a right rectus incision. Exploration showed the mesentery to be very thick and heavily laden with fat. There were two "cystic structures" in the cul-de-sac of the peritoneum which were removed. The appendix also was removed. Pathological examination of the appendix showed mild chronic inflammatory cell reaction. The "cystic structures" were appendices epiploicæ showing fat necrosis and foreign body granulomatous reactions.

Case 11.—Mrs. A.J., five and one-half months pregnant, complained of left lower quadrant colicky pain of 24 hours' duration. Physical examination was negative except for her pregnancy and an acute left lower abdomen. There was a very tender left cornu of the uterus, with marked rigidity and rebound tenderness in that area. No abnormal masses were felt. At operation both tubes and ovaries were normal. Exploration of the abdomen revealed a twisted appendix epiploica which was gangrenous. This was removed and the abdomen closed. Pathological examination revealed an infarcted appendix epiploica.

#### DISCUSSION

Experience over the past four years at two of the larger hospitals in Vancouver would indicate that disease of the appendices epiploicæ is encountered frequently enough so that every surgeon should be

TABLE I.—Appendicitis Epiploica: Data Summary of Principal Features

	Our Series (11 cases)	Literature (99 cases)	Overall (110 cases
I. Location of Pain			
Right Lower Quadrant	64%	48%	50%
Left Lower Quadrant	27	36	35
Elsewhere	9	16	15
II. Duration of Symptoms			
Less than one week	64	70	69
One week—one month	18	11	12
More than one month	18	19	19
II. Location of Discased Appendix Epiploica			
Sigmoid Colon	64	56	57
Cæcum	27	24	24
Elsewhere	0	20	19
IV. Preoperative Diagnosis	o .	20	10
Appendicitis (Vermiformis)	64	49	50
	18	6	7
Disease of pelvic organs		0	8
Diverticulitis	18	9	0
Tumour	18	3	9
Other	0	33	30

familiar with it. The fact that the pathology was not understood at the time of operation in five of the 11 cases in our series would suggest that insufficient consideration is given to this entity. In two cases the pathology was thought to be a "hæmorrhagic gland", in one case a "cystic structure", in another a "hard nodule" and in the other a "thrombosed clot".

For the four year period during which these cases were collected, there were 1744 cases of acute appendicitis at the Vancouver General Hospital, while there were six cases of appendicitis epiploica diagnosed as acute appendicitis. Thus, 0.3% of cases diagnosed as acute appendicitis turned out to be appendicitis epiploica; this frequency is closely comparable to the figure of 0.2% quoted by Fieber and Forman<sup>4</sup> for a 10 year period at Baylor University.

Table 1 summarizes the data from our series of 11 cases according to duration and location of pain, preoperative diagnosis, and location of the diseased appendix epiploica. Corresponding data on 99 previous cases from the literature are included for comparison. As can be seen from the table the two sets of data are remarkably similar. A comparison of our series with previous cases in the literature from the points of view of principal locations of symptoms and pathology is shown in Figs. 1a and 1 b. In the overall series of 110 cases 50% had pain in the right lower quadrant of the abdomen and 35% in the

left lower quadrant. The symptoms in most cases were acute; 69% were of less than one week's duration; 12% more were cf less than one month. In 50% of the cases a preoperative diagnosis of acute appendicitis was made.

None of the patients reported here was seriously ill at the time of operation. What might have been done had the correct preoperative diagnosis been known is a question of academic interest only since there is as yet no way of differentiating appendicitis epiploica from more serious conditions. Had there not been surgical intervention, the process in most instances would presumably have subsided after a varying period of distress. There is in the hospital records one case, not included in this series, where a surgeon recognized an infarcted appendix epiploica at operation and elected not to remove it; no consequences were reported. On the other hand, intestinal obstruction has been a sequela in 9% of the cases reported in the literature and 4% have resulted in death. It is apparent therefore that the treatment of choice is ligation and removal of the diseased structure.

The most typical situation in a diseased appendix epiploica is that an obese person comes in complaining of localized, nagging pain which is aggravated by movement. This pain will usually be in the right lower quadrant although it may be in the left lower quadrant if the appendix epiploica is located on the left side of the sigmoid.

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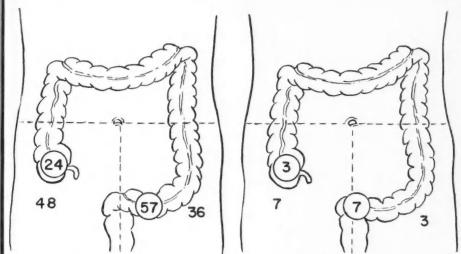


Fig. 1a.-Literature.

Fig. 1b.-Personal series.

Circled figures indicate site of pathology; symptoms are shown in plain figures.

colon. The patient is not severely ill and is in no great distress. The appetite is probably unaffected although there may be some anorexia or even some nausea. Bowel movements are normal. The urine will be clear, and the WBC in the neighbourhood of 10,000. Examination of the abdomen will show localized tenderness of moderately severe degree, with no rigidity but some guarding. A preoperative diagnosis of acute appendicitis will be made. At laparotomy a normal appendix will be found, but there may be some serosanguinous peritoneal fluid. Further exploration of the abdomen will reveal a diseased appendix epiploica.

#### SUMMARY

A series of 11 cases of strangulation of the appendix epiploica encountered at two Vancouver Hospitals over the past four years is presented and compared with 99 previous cases in the literature.

The cardinal symptom of the disease is localized pain in the absence of severe illness. It cannot be safely diagnosed preoperatively since there is no way of distinguishing it from more serious conditions. Usually it simulates acute appendicitis, and during the period of our series, 0.3% of cases diagnosed as acute appendicitis turned out to be appendicitis epiploica.

In five of the 11 cases of this series the lesion was not recognised at operation. In the overall series of 110 cases, the lesion was located on the sigmoid colon in 57% of cases, and on the cæcum in 24%; 69% of cases had symptoms of less than one weeks' duration. Pain was in the right lower quadrant in 50% of cases and in the left lower quadrant in 35%. Appendicitis, disease of the pelvic organs, and diverticulitis were the usual preoperative diagnoses.

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#### RÉSUMÉ

L'étranglement d'un appendice épiploïque est considéré, en général, comme étant rarement responsable d'un syndrome abdominal aigu. C'est ainsi que jusqu'à présent on ne peut trouver dans la littérature mondiale que 108 cas de ce genre. Ils sont cependant vraisemblablement plus fréquents qu'on ne le pense, mais ils ne sont pas diagnostiqués et passent inaperçus, la guérison étant le plus souvent spontanée. Les auteurs rapportent îci 11 cas d'étranglement d'appendices épiploïques, qui ont été rassemblés à l'Hôpital Général de Vancouver et à l'Hôpital St-Paul, pendant les quatre dernières années.

Le principal symptôme est une douleur localisée, qui n'est pas accompagnée d'un état morbide grave. Dans l'ensemble, le tableau clinique est celui d'une appendicite aiguë, et ce n'est donc pas une maladie que l'on peut diagnostiquer facilement préopératoirement. Les appendices épiploïques sont des petits sacs de péritoine remplis de graisse, dont la taille varie de quelques millimètres à quelques centimètres. On peut en trouver une centaine ou plus sur le côlon, en relation immédiate avec les taeniae. Ils sont plus gros chez les obèses et il est de fait que les troubles qu'ils provoquent sont plus fréquents chez ces malades.

Les statistiques montrent que les torsions ou les étranglements de ces appendices représentent 69% des cas lorsqu'ils sont situés sur le sigmoïde, 25% sur le cæcum, et 15% pour le reste du gros intestin. Les troubles commencent par une torsion de leur pédicule, ce qui entraîne la gangrène. Ils subissent alors une dégénérescence suivie de calcification, puis se détachent: on peut les re-

trouver libres dans le péritoine, connus conme "corpora aliena adiposa".

Les cas rapportés ici se répartissent en trois hommes et huit femmes. Les âges varient entre 17 et 57 ans. Les symptômes en sont résumére présentés sous forme de tableau. Dans cinq de ces cas, les lésions ne furent pas diagnostiquées au moment de l'intervention. Ceci montre, que dans cette affection relativement fréquente, l'attention du chirurgien doit être en éveil, lorsqu'il opère une "appendicite aigue".

Le tableau le plus typique est celui du mal de obèse admis à l'hôpital pour des douleurs loc dissées, aggravées, par les mouvements; la douleur peut siéger soit dans le quadrant inférieur droit, soit à gauche; l'état général n'est pas sérieusement modifié, si ce n'est que le patient présente une légère anorexie et quelques nausées. Les mouvements de l'intestin sont normaux, les urines ne présentent pas de caractères pathologiques, les globules blancs sont aux environs de 10,000. L'examen physique dénote une légère défense et on pose le diagnostic d'appendicite aiguë; lors de l'intervention, l'appendice est normal, mais une petite quantité de liquide péritonéal sérosanguinolent peut être épanchée. C'est à ce moment seulement q'une exploration abdominale plus poussée permettra le diagnostic correct. Le traitement sera l'excision de l'appendice épiploïque tordu, après ligature à sa base.

# PRE-EMINENCE OF SCIENTIFIC MEDICINE°

"That we are at a fascinating moment of the evolution of medicine is something that even the uninitiated observe: the advances achieved in this first half of our century are worth as much as all that was accumulated in many preceding centuries. Of course this prodigious advance could not have been attained without the work of those who preceded us. Present science already existed in the germ of the previous work; but the miracle of the seed does not at all lessen the majesty of the tree.

"It was in this century that medicine ceased to be purely clinical and anatomic comparison was no longer enough. A day came when detailed studies of organic function were required. To achieve them, physics and chemistry, biology and mathematics entered medicine, first imidly and then tumultuously, and with them came complex technics, precision instruments, and the rigors of mathematical analysis. It was the heyday of the laboratory and the beginning of a new era, the era of research. The so-called basic sciences came to change the traditional aspect of medicine, attempting to substitute scientific for empirical knowledge, and laboratory experiment for pure observation.

"It is impossible to trace the exact limit that separates the two epochs. Never in history

has it been possible to say where one age ends and another begins, and one must accept conventional boundaries. Even in the most radical changes, the ages superimpose or overlap, as happened with medieval and Renaissance medicine, when Galen continued to reign in physiology a century after Vesalius had begun his revolution in anatomy. If this happens in ages which are essentially opposed, as the medieval with its scholarly philosophy that became dogma, and the Renaissance with its scientific criterion that became free criticism, even greater difficulty exists in tracing the starting point of the scientific and experimental medicine of our

"The fact is that basically the difference is not essential but quantitative; medicine was already scientific earlier, especially that of the nineteenth century. One cannot ask for greater scientific exactness than that of Lænnec's comparisons or of Claude Bernard's experiments. Science could not be more precise than it was in the hands of Pasteur, of Koch, and of Virchow, nor was it even more disinterested and accurate than in Roentgen's experiments. It is not then, that our medicine is scientific and the other was not. The change comes rather from the fact that now it is not only a fragmentary aspect or an isolated field that is being transformed; all the fields of medicine are being attacked scientifically, all are being subjected to experimental methods, and in all, the basic sciences have entered to clarify problems."

<sup>\*</sup>Editorial: Grandeur and poverty of medical specialization, Circulation, 20: 482, 1959.

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# SHORT COMMUNICATION

## L'EQUILIBRE HYDROELECTROLYTIQUE AU LIT DU MALADE\*

J. TURCOT, M.D., F.R.C.S.[C] et S. PLOURDE, M.D., F.R.C.S.[C], Québec, P.Q.

IL EST MAINTENANT admis que l'usage d'un tableau hydroélectrolytique s'impose pour éviluer adéquatement les apports et les pertes chez les grands malades: notamment chez les opérés de grande chirurgie, et chez tous ceux qui subissent des pertes anormales de liquides organiques.<sup>2, 5</sup>

On connaît depuis longtemps les grands signes cliniques de la déshydratation: la langue sèche et rôtie, le pli cutané persis ant, les yeux creux, les urines rares et foncées, etc. Mais ces signes ne renseignent que sur l'existence d'une déshydratation avancée sans donner de notions précises que la quantité et la qualité des déficits existants.

Le laboratoire par de multiples dosages,<sup>4</sup> au cours de divers syndromes de déshydratation, a fourni à la clinique une contribution très importante en permettant une meilleure compréhension des changements humoraux qui accompagnent ces syndromes de déshydratation. L'explication pathogénique des principaux symptômes a conduit à des traitements rationnels. Ce rôle du laboratoire a été indispensable à l'acquisition de bien des connaissances qui, par la suite, sont devenues classiques, comme par exemple cette notion de rétention sodique consécutive à un "stress" considérable ou à une intervention chirurgicale. Néanmoins, tous les malades ne doivent pas devenir des cas de recherches cliniques. Au contraire, dans la plupart des cas, la clinique seule pourra donner tous les renseignements nécessaires à une thérapeutique rationnelle qui préviendra ou contrôlera l'état de déshydratation.3

La surveillance clinique sera faite d'observations précises sur les apports et les pertes liquidiennes du malade, tant au point de vue quantitatif, qu'au point de vue qualitatif; et même si le bilan chimique devient nécessaire, il ne pourra être interprété adéquatement que si l'on a devant soi l'évolution clinique du jour, donnée par les tableaux hydroélectrolytiques quotidiens

A cette fin, divers tableaux ont été étudiés depuis huit ou neuf ans, pour enfin arriver à ce modèle (Fig. 1) que nous utilisons maintenant depuis cinq ans. Ce tableau est placé près du lit du malade et tous les ingestats et les excrétats y sont inscrits au fur et à mesure par l'infirmière, au cours de la journée. Sont aussi indiqués les apports liquidiens par voies parentérales ou autres. La partie supérieure sert à

L'HOTEL - DIEU DE QUESEC

DOSSIER

LES APPORTS

VOIC ORALE

SOLUTES

SANG

SONDE

TOTAL

LES PERTES
SIPHON-VONIYUS

URINES

SELLES

DRAINAGES

EVAPORATION

TOTAL

LE BELAN

EAU (ML)

NA (MEQ)

CL (MEQ)

R (MEQ)

RUGGES (4)

AUTRES

PARS ACCOMBARS

APPORTS

PERES

PERTES

DIFFERENCE

PRESCRIPTION A FAIRE

Fig. 1.—Tableau hydroélectrolytique en usage à l'Hôtel-Dieu de Québec. Noter les trois parties —apports, pertes et bilan—où sont inscrits en ml. ou c.c. les ingestats, les infusions, les excrétats, les vomissements, les déficits ou les surplus et enfin au bas de la page, les ordonnances.

<sup>&</sup>lt;sup>o</sup>Travail du Service de chirurgie de l'Hôtel-Dieu de Québec.

Ce travail a été présenté à la réunion annuelle de la Société de chirurgie de Québec, le 23 mai 1959.

mesurer les apports; celle du mileu indiquera les pertes et la section inférieure servira à faire le bilan de la journée du patient. Les dernières lignes sont réservées aux ordonnances du jour.

Les calculs quantitatifs sont très facilement colligés par l'infirmière en millilitres (ml.) ou en centimètres cubes (c.c.). Les additions qualitatives sont faites par le chirurgien ou le résident à la tournée du motin

On connaît la composition des divers liquides organiques; cependant ces humeurs ne sont presque jamais trouvées à l'état pur dans les liquides perdus par le malade. Il s'agit généralement de mélanges de plusieurs d'entre elles ensemble. Aussi a-t-il fallu adopter une mensuration globale, facile et pratique, et qui réflète aussi la somme des pertes subies par le patient. Il a donc été décidé de compter 150 mEq./l. pour tous les liquides du tube digestif: vomissements ou suction gastrique composés de sucs gastriques, de bile et de sucs intestinaux; drainage biliaire et diarrhée. C'est donc le compte ionique d'une solution isotonique. Tel ne sera pas le cas cependant, dans l'éventualité de vomissements par sténose pylorique: il s'agit alors de suc gastrique pur.

Pour ce qui est de la composition électrolytique de l'urine, sachant que celle-ci, selon les circonstances peut être soit très concentrée, soit isotonique, soit très diluée, il a été décidé de faire une moyenne et de compter 40 mEq./l. On ne compte généralement aucune perte ionique pour la sueur, à moins qu'il ne s'agisse de sudation excessivement abondante. Notons cependant que l'on alloue de 500 à 700 c.c., quantitativement, pour les pertes insensibles, subies par l'organisme humain pour 24 heures. Ce chiffre sera très augmenté, s'il y a transpiration profuse.

Se basant, sur ces chiffres plus ou moins arbitraires au point de vue totaux, mais réalistes au point de vue moyennes, il est facile de faire le bilan hydroélectrolytique du patient pour 24 heures.

# Etablissement des ordonnances:

En vue de faciliter et de standardiser les ordonnances, 7 une norme quotidienne minima des liquides et substances obliga-

toires pour tous les jours a été établie. Les valeurs qui suivent représentent donc le minimum des apports quotidiens que tout patient doit recevoir:

H2O 2000 c.c.

Na
75 mEq.
Cl
75 mEq.
K
40 mEq. (3e jour)
Glucose
100 g.
Autres
Vitamines B and C

Connaissant les surplus ou les déficits accumulés par le patient, au point de vue hydroélectrolytique pour les dernières 24 heures; et sachant les minimums requis pour ce jour, il devient extrêmement facile d'établir les ordonnances. Le résultat du bilan aqueux donnera les quantités, liquidiennes à administrer au malade au cours des prochaines 24 heures et les besoins ioniques indiquent lesquelles des solutions standards ou modifiées seront utilisées.

#### Conclusions

Les résultats obtenus en utilisant ce tableau sont des plus satisfaisants.

Il est extraordinaire de constater avec quelle facilité l'on suit les diverses perturbations qui surviennent chez le malade; et avec quelle égale facilité on peut les corriger.

Il est aisé de se rendre compte jusqu'à quel point on aurait pu être induit en erreur en l'absence d'une telle table.

Ce tableau a une grande valeur éducative, aidant le résident à comprendre la physiologie et la physiopathologie du métabolisme de l'eau et des électrolytes.

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#### SUMMARY

For several years the authors have used a special char for recording the fluid intake and output of patients in the immediate postoperative period. In their experience this chart has proven most usef 1 on many occasions. It is divided in three sections, the first devoted to the oral and intractivel; the second records the output (urine,

diarrhœa, vomitus, gastric suction, biliary drainage, sweat and insensible perspiration). Although the concentration of electrolytes of any of these may vary over a fairly wide range, the following values have been selected as practical averages in computing the amount of replacements needed: all G.I. fluids are rated at 150 mEq./l.; urine, at 40 mEq./l. The third section is a balance sheet which shows the patient's status at the end of any 24-hour period. Space is allotted at the bottom for writing the required prescriptions for the next day. Although this method is not meant to be as accurate as various biochemical determinations it is nevertheless a practical way of interpreting these determinations when they are reported, and is very useful for the daily prescription of I.V. fluids.

## LES DANGERS DE LA SPECIALISATION°

. Il n'est pas question de faire ici le procès de la spécialisation. Cette dernière est actuellement nécessaire et indispensable au progrès de la science médicale, mais elle devient dangereuse, dès que l'horizon de la recherche se limite à un seul sujet que l'on maîtrise et connaît en profondeur dans tous ses détails, mais qui nous oblige à délaisser d'autres domaines d'importance aussi vitale et nous fait souvent oublier, dans la fièvre de la recherche, que nous devons penser non seulement au problème biologique pur, mais aussi au salut du malade. Celui-ci accablé par la maladie, se confie à nous avec tous ses soucis, ses sentiments et son univers caché que nous sommes tentés d'ignorer, car nous pouvons être aveuglés par la préoccupation de la recherche ou ne pas connaître suffisamment les notions fondamentales de la médecine que nous professons.

"Le spécialiste court petit à petit le danger de se transformer en technicien; sans s'en apercevoir, il perd la vue d'ensemble sur la médecine, la vision humaine de son monde. Il sacrifie pour le détail sa culture générale et son sens du réel.

"Cependant, l'évolution de la science n'exerce pas seulement une influence sur notre travail quotidien de médecin. Les grandes agglomérations urbaines qui se développent autour des usines et des grandes entreprises commerciales provoquent le dépeuplement des campagnes et le rôle primordial du village, de la communauté, dans la nation, est toujours plus réduit. La fabrique, réalisation pratique des progrès de la science, peut représenter une menace pour la liberté et l'intégrité spirituelle de l'individu.

"L'homme moderne, englobé dans les grandes organisations de travail, protégé par les assurances sociales et aspirant à la retraite s'adapte à cette mentalité de la masse; il perd l'intérêt pour le travail individuel, pour la réussite personnelle; il perd l'amour de son métier, le goût de la compétition et du succès; il devient un élément anonyme de la grande machine de la rationalisation industrielle. En dehors de son travail, même sa vie privée, ses loisirs s'organisent petit à petit, se règlent selon des critères collectifs.

"Cet homme, dépossédé de sa personnalité et protégé par une assurance ou une caisse de retraite, se réfugie souvent dans la maladie. Il arrive dans nos hôpitaux, encombre nos salles d'attente sans se rendre compte qu'il souffre souvent des conséquences morales et psychologiques du collectivisme gigantesque qui gagne toujours plus tous les pays hautement civilisés.

"C'est aussi contre ce danger que le médecin doit lutter, en faisant preuve de psychologie avec son client, en évitant par son honnêteté professionnelle les abus qui peuvent intervenir entre l'assuré et la caisse-maladie, en signalant aux autorités, aux entreprises et aux assurances les dangers réels que court chaque individu faisant partie des puissantes organisations économiques qui règlent le travail de la collectivité humaine actuelle.

"Cette situation crée un malaise qui commence à se faire sentir dans la société et aussi dans la médecine qui, parmi toutes les autres disciplines, doit trouver sa raison d'être dans l'équilibre harmonieux entre notre vie intellectuelle et les sentiments qu'éveille en nous la contemplation sereine de la nature. ..."

VANOTTI, A.: Presse Méd., 67: 2115, 1959.

# CASE REPORT DUODENUM INVERSUM

J. E. ANDERSON, M.D., \* Toronto

#### DESCRIPTION OF SPECIMEN

An abnormality of the duodenal region was studied *post mortem* in a 70 year old man whose stated cause of death was cerebral thrombosis.

Fig. 1 is an anterior view of the abdominal viscera removed en bloc from this subject. Rather than partially surrounding the pancreas in a four sided frame, the duodenum lies to the right of the pylorus in a series of loops forming hairpin bends. Basically, these loops form two inverted horseshoe-shaped segments continuous with each other inferiorly, and bound together by peritoneal adhesions. The first of these segments runs to the right: the second swings to the left to join the jejunum and so comes to lie posteriorly to the first loop.



Fig. 1.—The viscera as seen from in front. The stomach and duodenum are outlined with white string. Below is the transverse colon with dependent greater omentum.

The blood supply passes in the potential space between these two segments to the duodenum. The first segment is supplied by branches derived from the hepatic artery; the second by branches of the superior mesenteric. The bile duct runs downwards in this space between tortuous branches of the gastro-duodenal artery anteriorly, and many straight branches of the superior pancreatico-duodenal posteriorly.



Fig. 2.—The viscera, removed from the body and viewed from behind. Loops of bowel are outlined by strips of white plastic. Above, the duodenum leads into the jejunum.

Fig. 2 is a posterior view of the abdominal viscera. As may be seen, the duodeno-jejunal junction lies to the right of the body, and the small bowel passes posteriorly to the transverse colon and its mesentery. Arrangement of the large bowel is essentially normal. The superior mesenteric artery does not bear its usual relationship to the third part of the duodenum, the latter lying totally to the right of the artery's origin. Thus the first branches of the superior mesenteric artery fan out to the right. The unusual radiological appearance of this anomaly is illustrated in Fig. 3.

#### DISCUSSION

Duodenum inversum is a congenital anomaly in which the duodenal loop is arranged in a clockwise rather than an anticlockwise manner. This variation is not to be confused with "situs inversus" in which the duodenum occurs on the left side of the body.

Sheehan and Kelly<sup>3</sup> divide cases of luodenum inversum into four types.

1. All parts of the duodenum are snort, with the third and fourth parts not demarcated.

2. The duodenum appears normal until reaching the third part which, instead of turning medially runs upwards parallel to

<sup>\*</sup>Assistant Professor of Anatomy, University of Toronto.

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the second part and then swings medially to the duodeno-jejunal junction.

8. The duodenum is unusually long with a redundant superior part.

4. The duodenum is all on the right side and the large bowel is in a non-rotated position on the left.

A survey of the literature discloses about 70 reported cases of duodenum inversum which have been discovered either from the radiological appearance of patients undergoing a barium meal after presenting with symptoms related to stomach or duoderum, as a chance finding at operation, or not the dissecting room, in cadavers with no known history of gastrointestinal disturbance during life.

The commonest reported types are 2 and 4. The incidence of duodenum inversum is difficult to determine from the literature which consists mainly of reports of individual cases. However, Feldman and Morrison<sup>2</sup> report 14 cases in a survey of 20,000 radiographic examinations of the gastrointestinal tract, giving an incidence of 0.07%.

Duodenum inversum results from developmental errors occurring during the rotation of the midgut. This rotation has been classically described by Dott.<sup>1</sup>

The case presented here falls into the category of Type 2 and may be due to an unusual clockwise rotation of the duodenum on the axis of the attachment of the bile duct which is an early fixed point. Another possible cause is late fixation of the dorsal mesentery allowing the duodenum to be influenced by subsequent visceral movements which alter its position.

#### SUMMARY

A case of duodenum inversum is described in which the duodenum, rather than surrounding the head of the pancreas, is arranged in coils to the right of the pylorus. This, a developmental anomaly of rotation, is of practical significance when discovered in radiography or surgery of the upper gastrointestinal tract.

#### ACKNOWLEDGMENTS

I am pleased to acknowledge my gratitude to Professor J. W. A. Duckworth for critical reading of the manuscript, and to Mr. Charles Storton who did the photography.



Fig. 3.—A radiograph of the cadaver with viscera in situ, undisturbed. A metal rod is lying along the transverse colon to indicate its plane. Barium has been injected through the pylorus and fills the duodenum and first part of the jejunum.

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#### RÉSUMÉ

L'auteur rapporte la découverte qu'il fit par hasard au cours de la dissection d'un sujet âgé de 70 ans mort d'une thrombose cérébrale, d'un duodénum inversé. Cette anomalie consiste en une disposition du duodénum en boudin à droite du pylore au lieu de sa position normale autour de la tête du pancréas. On ne doit pas la confondre avec l'inversion viscérale dans laquelle le duodénum est à gauche de la ligne médiane. On prétend que la fréquence de cette anomalie serait de 0.07%; malgré sa rareté elle n'en possède pas moins un intérêt clinique qui se manifeste à la radiographie ou à la laparotomie pour intervention sur les voies intestinales supérieures.

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#### ROYAL COLLEGE OF PHYSICIANS AND SURGEONS OF CANADA

#### CONVOCATION

THE 1960 CONVOCATION of the Royal College of Physicians and Surgeons of Canada was the first which had been held in a un versity setting. Previously, all Convocations had been held in the hotel where the Annual Meeting was itself taking place, bu the Committee on Local Arrangements fel that it would now be preferable to ho d this ceremony in a university setting. The University of Montreal were only too wi ling to assist in this scheme, and they provided their excellent auditorium as well as a most efficient and co-operative staff. In the official platform party at Convocation, Monseigneur Irénée Lussier represented the University of Montreal and gave the invocation. Also on the platform representing the American College of Physicians was Dr. Chester Keefer, President-Elect of that body, and Dr. J. Barrett Brown of St. Louis, Vice-President of the American College of Surgeons.

One hundred and eighty-seven new Fellows were presented at Convocation. Dr. F. S. Brien, Vice-President in the Division of Medicine, presented the Medical Fellows to the President, while Dr. Charles Hébert, Vice-President Elect in the Division of Surgery, presented the Surgical Fellows. Dr. Wendell Macleod presented Dr. K. J. R. Wightman, Lecturer in Medicine, to the President for his Diploma as Lecturer, and Dr. Charles Hébert presented Dr. H. Rocke Robertson to receive the surgery diploma. Dr. Douglas Cameron presented Dr. J. C. Sinnott of Charlottetown, as recipient of the Medal in Medicine, and Dr. F. G. Kergin presented Dr. R. B. Salter of Toronto, the Medallist in Surgery. Also in the platform party, in addition to the Council of the College, were the Deans of the Faculties of Medicine of the University of Montreal and McGill University respectively, Dr. Wilbrod Bonin and Dr. Lloyd Stevenson. The Convocation was followed by a reception at which a vin d'honneur in the traditional French Canadian style was served to the guests.

#### PRESIDENTIAL ADDRESS

Dr. John W. Scott, President of the



Dr. Donald A. Thompson President of the Royal College of Physicians and Surgeons of Canada.

Royal College, addressed the Convocation, and the Fellows and the audience were also addressed in French by Dr. J. Roméo Pépin, a retiring member of Council. Dr. Scott's address is reprinted below.

We are priviliged on this the Thirtieth Anniversary of the founding of the Royal College of Physicians and Surgeons of Canada in meeting in this magnificent convocation hall of the University of Montreal. May I express to Monseigneur Lussier, Rector of the University, our gratitude. The academic setting of a great university adds to the dignity and graciousness of our College Convocation.

The Thirtieth Anniversary of the founding of our College may be an appropriate time to review with you its functions and to examine the place of the College in the framework of medical education and practice in Canada,

Undergraduate education in all the learned professions, including medicine, is and will, it is hoped, always be a function of the universities of Canada. There is no unanimity of opinion as to what constitutes the ideal curriculum or the best methods of



Dr. John W. Scott, Past-President of the Royal College of Physicians and Surgeons of Canada.

teaching undergraduate medicine. However, in spite of this, one feels that the university faculties of medicine, in the 12 medical schools of Canada, are doing a creditable job in training and graduating, as they do, about 900 doctors each year.

The setting and maintenance of minimal standards for the practice of medicine in Canada is primarily the duty of the provincial licensing bodies, working in conjunction with the Medical Council of Canada. Until the founding of our College 30 years ago, the upgrading of the minimal qualifications for licence to practise medicine was left largely in the hands of the individual doctor. He, through his reading. his increasing experience in practice, his association with his colleagues in professional societies, and his attendance at postgraduate courses, attempted to keep abreast of the newer advances in the complex and dynamic field of medicine.

In the first half of this century, university faculties of medicine in Canada, with a few exceptions, were concerned primarily with undergraduate teaching. They took no responsibility for organized integrated programs of clinical graduate training. In

the early part of the century, the recognition of the competence of a Canad an physician or surgeon in a special field of medicine or surgery was determined largely by the judgment of his colleages in the area in which he was known to them. This means of recognition was not without merit and in many instances he judgment given was sound.

In the twenties a small group of physicians in Canada brought forward to the meetings of the Canadian Medical Association the concept that there should be available in Canada a recognized body for the evaluation of graduate training and competence in medicine and surgery. This was "le premier pas" in the history of the Royal College of Physicians and Surgeons of Canada,

The founders of the College had in mind the pattern of the Royal Colleges of physicians and Surgeons in England and Scotland. However, the medical milieu of 20th century Canada was very different from that of 16th and 17th century England and Scotland. It was wisely decided that a Canadian college should concern itself with the direction of graduate training in Canada and the evaluation, by rigid tests, of the competence of the individual on the completion of a prescribed course of training.

With this in mind, the founders requested the Parliament of Canada to pass a bill giving them a charter to set up such a college. This was done in 1929. We are very happy that Dr. Sclater Lewis, archivist of our College, has under preparation a College history which will, we hope, be published this year. Dr. Lewis has had access to the early records and as a former president and charter Fellow has an intimate knowledge of our development I have had the privilege of reading part of the manuscript. The story is a fascinating one with many interesting sidelights on contemporary medicine and on the colourful vigorous personalities who played 1 role in the enterprise.

It is not my purpose to burden you w th historical details this evening. May I, ho vever, point out to you that from a modest beginning in 1930 with an interest limited

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At the 29th Annual Meeting of the Royal College of Physicians and Surgeons of Canada, held in Montreal on January 21-23, 1960, Dr. Charles E. Hébert, Montreal, Vice-President in Surgery, is seen with Dr. Donald A. Thompson, of Bathurst, N.B., President; Dr. L. G. Bell, Winnipeg, Vice-President in Medicine; and Dr. John W. Scott, Edmonton, Past-President.

to graduate training and examinations in internal medicine, general surgery, obstetrics and gynæcology, the College now assesses training, approves the training hospitals, and conducts examinations in over 20 specialties in the broad fields of medicine and surgery.

There are now over 2000 Fellows of the College. In addition, over 7000 individuals have been certificated by the College in a specialty.

How has this program influenced medical education and practice in our country? I think one can justifiably claim that the guidance given to the recent graduate in planning a program of training leading to Fellowship or Certification in a specialty has been of the greatest value. The Council has always kept in mind that the training programs should not be rigidly laid down with a view to providing conformity to a fixed pattern. The program should and does stimulate depth as well as breadth in the learning process during training. The acceptance of the importance of the basic sciences of medicine has been kept in mind in all areas.

The conduct of searching, written and practical examinations has allowed the College to admit to its Fellowship only those who have attained excellence. We would like to think that the prestige of the

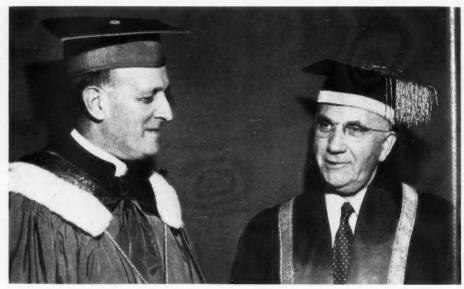
Fellowship ranks high in both university and hospital circles in Canada and throughout the Commonwealth as a hallmark of medical attainment.

While the interest of the College is primarily in the field of graduate medical education, one feels that the appointment of Fellows of our College to teaching positions in the clinical departments of Canadian medical schools has improved the standard of undergraduate clinical teaching.

Medical education and the medical care of the patient are inseparable in a teaching hospital. Our College through its representation on and partial support of the Canadian Council on Hospital Accreditation is contributing to the maintenance of improved hospital care in this country.

The initial objectives of our College are being realized in that we have provided an accepted method for the evaluation of graduate training. I am confident that the quality of medical practice has improved in all areas of Canada as a result of our Fellowship and Certification programs.

One must recognize that, however proficient the doctor may be as a practitioner or teacher, his ethical standards in his dealings with his colleagues and his patients will be among the criteria by which he



Monseigneur Irénée Lussier, Rector of the University of Montreal, with Dr. Scott at the 1960 Convocation of the Royal College, held in the auditorium of the University.

himself and the profession at large will be judged at the bar of public opinion.

The best defence against criticism of us as individuals or as a group is the recognition by those whom we serve that our chief concern is the best interests of the patient. Francis Peabody expressed this very simply and beautifully 30 years ago by saying that "one of the essential qualities of the physician is an interest in humanity, for the secret of the care of the patient is in caring for the patient."

One hopes that our College will continue to maintain an interest in ethics as well as scholarship and competence as an essential quality in its Fellows.

## 1959 FELLOWSHIP EXAMINATIONS OF THE ROYAL COLLEGE

THE FOLLOWING CANDIDATES in surgery were successful in the 1959 Fellowship Examinations of the Royal College of Physicians and Surgeons of Canada.

General Surgery (53).—Morris Asa, Windsor, Ont.; Ronald James Baird, Toronto; William Henry Barnes, Hamilton, Ont.; Edward James Beaton, Barrie, Ont.; Georges Bédard, Hull, Que.; Sarab Singh

Bhatia, New York, N.Y., U.S.A.; Donald Kenneth Black, Regina; Claude Brunet, Quebec, Que.; Frederick William Campbell, Jr., Minneapolis, Minn., U.S.A.; William Stephen Cave, Kelowna, B.C.; Ralph Marenus Christensen, Vancouver; Wallace Bakfu Chung, Vancouver; Gerald Coursley, New Westminster, B.C.; Joseph Stephen David, Toronto; Gordon Russell Davies, Saskatoon; Jean-Paul Després, Quebec, Que.; Joseph-Raymond Fernand Desrosiers, Loretteville, Que.; Robert Orme Farley, St. Thomas, Ont.; Gaston Forget, Montreal; Jacques Bertrand Gagnon, Montreal; Carstairs Clouston Gardner, Oshawa, Ont.; Brian Cameron Gay, Ottawa; Robert Kingsley Graham, Manitouwadge, Ont.; George Yoshinori Hiraki, Toronto; John Donald Hough, Victoria, B.C.; Harry Alexander Hyde, Toronto; Neville James Jackson, Saskatoon; John William Kerr, Kingston, Ont.; Ratan Kumar Keswani, Charlotte:ville, Va., U.S.A.; Claude Lafortune, Jolietta, Que.; Richard A. Lambert, Thetford Mines, Que.; Allan Meredith Lansing, Chicag, Ill., U.S.A.; Louis Joseph Laporte, Vile St-Laurent, Que.; Raymond Denis Joseph LaRocque, Windsor, Ont.; Manly Bernard Levin, Winnipeg; James Forest Lind,

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Rochester, Minn., U.S.A.; Jacques Alfred Loeb, Toronto; John Duncan Claude Macdonald, Brookfield, Wis., U.S.A.; Ian Donald MacLeod, Weyburn, Sask.; John Andrew McCredie, London, Ont.; Norman Voods Mortimer, Toronto; William Lindsay Cgilvy, Montreal; Radha Krishna Padhi, Kingston, Ont.; Arthur Albert Pagé, Knowlton, Que.; Charles Roy Palmer, Parry Sound, Cnt.; Cyrille Jean Joseph Paquette, Montreal; Sabin Plourde, Quebec, Que.; Terence Alvin Richards, Hamilton, Ont.; Walter Rolland, Brantford, Ont.; Irving Bernard Rosen, Toronto; Ernest Bhasker Sundaram, Montreal; Walter Govan Waddell, Toronto; John Kenneth Wyatt, London, Ont.

Surgery (Neurosurgery) (6).—Antonin Frechette, Trois-Rivières, Que.; Rankin Kilgour Hay, Winnipeg; Sonis Napoléon Martinez, Montreal; Kenneth William Ellis Puine, Saskatoon; Ronald Reginald Tasker, Toronto; Gordon Bruce Thompson, Montreal.

Surgery (Obstetrics and Gynæcology) (23).-Kenneth Baker, Edmonton; Cecil Ronald Bradford, Winnipeg; John David Toronto; John Alexander Carmichael, Regina; Jacques Corbeil, Verdun, Que.; Bernard Allan Davis, Montreal; Robert Findlay Edington, Cornwall, Ont.; William Gordon Francis, Toronto; William Denis Fraser, Montreal; Ashley Milton Krisman, Vancouver; Jules Eugène Leclerc, Quebec, Que.; Samuel Librach, Toronto; Robert King Miller, Oshawa, Ont.; Ely Ravinsky, Willowdale, Ont.; Martin Lyle Robinson. Toronto; John Walter Fraser Scrimgeour, Fort William, Ont.; Narinder Nath Sehgal, Ottawa; Thomas John Sheppard, Peterborough, Ont.; Stuart Donald Sims, Toronto; William Langford Tew, London, Ont.; Charles Peter Vernon, Toronto; James Garnet Courtland White, Brantford, Ont.; William George Whittaker, Peterborough, Ont.

Surgery (Ophthalmology) (1).—Samuel Walter Nevil Gibson, South Burnaby, B.C.

Surgery (Orthopædic Surgery) (12).— Jean-Claude Caron, Paris, France; William Gerard De Haas, Calgary; Fergus Albert Ducharme, Ottawa; John Graham Evans, Toronto; Michael Clement Hall, Toronto; George Davidson Kay, Toronto; Paul Mailhot, Montreal; Kenneth Alan McCluskey, Doncaster, Ont.; Yves Normand, Trois-Rivières, Que.; Bruce Guy Sadler, Sillery, Que.; Albert McMurdo Sinclair, Halifax, N.S.; Alan Murray Wiley, Toronto.

Surgery (Otolaryngology) (1).—George Shimo-Takahara, Montreal.

Surgery (Plastic Surgery) (2).—Pierre Paul Gagnon, Quebec, Que.; Edward Michael Gold, Montreal.

Surgery (Urology) (5) — Neil Calvert Carruthers, Sarnia, Ont.; Gordon Leath Henderson, Windsor, Ont.; Calvin Clarence Krause, Brooklyn, N.Y., U.S.A.; William Hall Lakey, Ann Arbor, Mich., U.S.A.; Lauréat J. E. Tremblay, Chicoutimi, Que.

## NEWSLETTER

AT THE RECENT Annual Meeting of the College held at the Queen Elizabeth Hotel, Montreal, Dr. Donald A. Thompson of Bathurst, N.B. a Fellow of the College in the Division of Surgery, was installed as the new President of the Royal College of Physicians and Surgeons of Canada for the term 1960-1962. Dr. Thompson succeeds Dr. John W. Scott of Edmonton, who continues to serve on the Executive Committee and the Council as the Immediate Past-President. The election of Dr. Thompson is unique in that it is the first time that this important post will be occupied by a Fellow from a non-university centre.

Dr. Lennox G. Bell of Winnipeg was elected Vice-President for the Division of Medicine and Dr. Charles E. Hébert of Montreal, Vice-President in the Division of Surgery. Dr. James H. Graham, Secretary, Dr. W. Gordon Beattie, Honorary Assistant Secretary, both of Ottawa, and Dr. Kenneth T. MacFarlane of Montreal, Honorary Treasurer, were reappointed to office.

Dr. Walter C. MacKenzie of Edmonton, was elected to the Council of the College in the Division of Surgery for the period 1960 to 1964. Three other vacancies representing the Division of Surgery on the Council for this period were filled by the re-election of Dr. Percy E. Ireland of Toronto, Dr. Louis-Philippe Roy of Quebec City and Dr. Donald R. Webster of Montreal.

In January 1959, the Council directed the Credentials Committee, in consultation with the Specialty Committees of the College and the National Specialty Societies, to modify the training requirement so that a single standard of training would apply for both Certification and Fellowship examinations. Such a single standard of training had been adopted previously in Neurosurgery and Orthopædic Surgery.

At its meeting in January 1960, the Council adopted, on the recommendation of the Credentials Committee, the single standard of training in the following fields of surgery: General Surgery, Obstetrics and Gynæcology, and Otolaryngology. Commencing in 1964 and thereafter, candidates for either the Fellowship or Certification examinations in these specialties must comply with the following revised training requirements:

#### GENERAL SURGERY

The new requirements represent only the deletion of the one year of supervised practice of General Surgery from the old requirements for the Certification examination in General Surgery.

- An approved general internship of at least one year.
- Four years of graduate training in addition to the general internship. This period must include:
  - (a) Two years of approved resident training in Surgery. One of these years *must* be on a general surgical service; the remaining year may also be spent on a general surgical service or, as an alternative, may be divided between special surgical services if such services are approved.
  - (b) Two years of training which may include:
    - (i) Further approved resident training in General Surgery.
    - (ii) One year as a clinical research fellow in a department approved by the College.
    - (iii) One year in the full-time study of basic science in a department approved by the College.
    - (iv) Six months of approved resident training in Internal Medicine and six months of approved full-time study of basic science.
    - (v) One year in an approved

- course of study and training at a hospital or university centre in Canada or abroad.
- (vi) One year of approved resider training in Internal Medicin.

#### OBSTETRICS AND GYNÆCOLOGY

The revised requirements provide for a a additional option of six months of approve I resident training in Pathology under Section 2(a) of the regulations and the delation of the year of supervised practice (f Obstetrics and Gynæcology from the requirements for the Certification examination in Obstetrics and Gynæcology. No change has been made in the requirements for the Certification examination in Obstetrics or the Certification examination in Gynæcology.

- An approved general internship of at least one year.
- Four years of graduate training in addition to the general internship. This period must include:
  - (a) One year of approved resident training in General Surgery, or six months of approved resident training in General Surgery and six months of approved resident training in Internal Medicine or Pathology.
  - (b) Two years of approved resident training in Obstetrics and Gynæcology. This *must* be of such a nature as will provide adequate training and experience in each branch of the specialty.
  - (c) One year of training which may include:
    - (i) One further year as under 2(b).
    - (ii) One year as a clinical research fellow in a department approved by the College.
    - (iii) One year of full-time study of basic science in a Department approved by the College.
    - (iv) If no time was spent on Internal Medicine under 2(a, six months of approved redent training in Internal Medicine and six months of approved full-time study of basic science.
    - (v) One year in an approved course of study and training at a hospital or university centre in Canada or abroac.

#### OTOLARYNGOLOGY

The revised requirements in Otolaryngology remove the mandatory requirement or one year of approved resident training in General Surgery or six months of approved resident training in General Surgery nd six months in Internal Medicine, though it will be noted that such a year is a preferred option under Section 2(b) of the revised requirements. The options provided under this section represent an ..dditional year of training beyond the preious requirements for the Certification examination in Otolaryngology. The wordng of Section 2(a) of the revised requirenents in this specialty as it will appear in he printed regulations may undergo further changes but the principle of three years of approved training in the specialty has been idopted.

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2. Four years of graduate training in addition to the general internship. This

period must include:

(a) Three years of approved training in Otolaryngology, two years of which must be spent in approved resident training in Otolaryngology and one year of which may be spent in further approved resident training in Otolaryngology or such other training in Otolaryngology as may be approved by the Credentials Committee.

(b) One year of training which may include:

(i) One year of approved resident training in General Surgery.

(ii) Six months of approved resident training in General Surgery and and six months of approved resident training in Internal Medicine. (Either (i) or (ii) to be preferred but not mandatory.)

(iii) One year in the full-time study of basic science in a department ap-

proved by the College.

(iv) One year in an approved course of study and training in Canada or

(v) One year as a clinical research fellow in a department approved by the College.

At the January meeting, the Council adopted the recommendation of the Committee on Examinations, that the general medical and general surgical examiner on the Board of Examiners for the oral examination in pathology in the medical and

surgical subspecialties, be dropped from the Board. Accordingly, commencing in 1960, the Board of Examiners for the oral examination in pathology in the medical and surgical subspecialties will be composed of examiners representing pathology and the

specialties concerned.

Due to the increase in the number of candidates for the Fellowship and Certification examination in General Surgery and the Surgical Specialties, with the resulting increased time required to complete the oral and clinical examinations of these candidates, it has been decided that the oral and clinical examination in General Surgery and those in the Surgical Specialties will be conducted concurrently in the same week, rather than consecutively as has been the practice in the past.

Because of the increased demand which this procedure will place on the facilities for conducting the oral examination in pathology, it will be necessary to have the oral and clinical portion of the examinations for Fellowship and Certification in Surgery and the Surgical Specialties and those in Medicine and the Medical Specialties conducted in different centres. In 1960, therefore, the oral and clinical portion of the Fellowship and Certification examinations in General Surgery and the Surgical Specialties will be held in Toronto, and those in Medicine and the Medical Specialties

Candidates for the Certification examinations of the College are again reminded that in 1960 and thereafter, a licence to practise in one of the provinces of Canada, or the degree of Licentiate of the Medical Council of Canada, is a prerequisite to

eligibility for these examinations.

Following upon the success of Eastern Regional Meeting held in Halifax in October 1959, a Western Regional Meeting to be held in Saskatchewan during 1960 has been authorized, the site and date to be determined later. As in the case of the Eastern Regional Meeting, the Western Regional Meeting will be open to attendance by Certificants of the College and the profession at large. Further information concerning the time and place for this meeting will be announced in a future Newsletter.

> W. GORDON BEATTIE, F.R.C.S.[C], Honorary Assistant Secretary

February 29, 1960

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# **BOOK REVIEWS**

(See also page 228)

ANGEWANDTE UND TOPOGRAPHISCHE ANATOMIE (Applied and Topographical Anatomy). G. Tonduery. 578 pp. Illust. Georg Thieme, Stuttgart, W. Germany; Intercontinental Medical Book Corporation, New York, 1959. \$18.80.

German-speaking physicians wishing to refresh their memory on points in regional and applied anatomy will find a concise and beautifully illustrated account of the subject in this textbook. The first edition has already been translated into Italian and Spanish and the second one has undergone considerable revision. The new Paris terminology is used throughout, and revisions include new material on the lungs, the inguinal region and the pelvic floor. The account of each region is introduced by a brief survey of its embryology, since the author considers that the embryological approach is the best in explaining topography.

HOSPITAL AND COMMUNITY. History of the Royal Melbourne Hospital. K. S. Inglis. 226 pp. Illust. Melbourne University Press, Victoria, Australia; The Macmillan Company of Canada Limited, Toronto, 1958. \$5.00.

The Royal Melbourne Hospital, one of Australia's most famous medical institutions, had its origins in 1841 when a group of private citizens called a public meeting to consider fundraising for the provision of a hospital in the new town. They had previously sought, and failed to obtain government funds for the project, and the main theme of Inglis's most admirable history of the hospital is the interplay of private charity and the state in the financing and control of a necessary medical facility.

As a history of a great hospital, told with wit and intelligence, it must rank high. As a social document, it will also be of interest to a wide range of readers for its objective discussion of many issues connected with medical care.

For the first 50 years of its life the Hospital seems to have been a centre of controversy. For 40 years discussion raged over its rebuilding or relocation—in any event, it was first rebuilt in 1913 and then relocated in 1944 in its present home, to which it might well have moved 70 years earlier. Other evidences of the leisurely pace of democracy are the fact that it took 25 years of agitation to get an eye department, and the even more astonishing fact that the first Melbourne professors of medicine and surgery were appointed only in 1955, 70 years after the appointments had first been suggested. In 1891, Allen, the pathologist, wanted a research institute; in 1919 it was built and now has Sir MacFarlane Burnet as its distinguished head.

The book is full of delightful detail, such as the story of the tuberculous girl who in about 1880 was prescribed seven bottles of rum and 12 bottles of brandy in a 28 day stay, and the suggestion by a hostile newspaper that sensible persons should carry cards giving their name and address, and a note "If any accident should happen to me, do not on any account take nie to the Melbourne Hospital". This pre-Listerian attitude had its justification, for in 1870 a Melbourne doctor said that no one with the least experience of disease could doubt that a patient at home had a far better chance of recovery than in hospital. One of the reasons for increased use of modern hospitals is, as Inglis points out, the gradual abandonment of the public attitude of fear of them.

In spite of the remoteness of the setting, anyone interested in hospitals will find something entertaining and instructive in this well written historical monograph.

LESIONS OF THE LOWER BOWEL. Raymond J. Jackman. Mayo Clinic, Rochester. 347 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1958, \$17.00.

This 350 page book on good quality paper is chiefly concerned with the diagnosis of lesions of the lower bowel, particularly as seen through the sigmoidoscope. The different lesions are discussed briefly in the text. An outstanding feature of the book is the colour atlas, consisting of 75 plates of anal and rectal lesions, mostly as seen through the sigmoidoscope and recorded by colour photography. Some non-surgical methods of treating lesions in this area are discussed. The technique of transrectal biopsy of intramural and extra-rectal tumours is described. This is an excellent book by an author with great experience in this field, and a book that anyone working in this field would wish to peruse.

ANESTHESIA FOR INFANTS AND CHILDREN. Robert M. Smith, Anesthesiologist, Children's Medical Center, Boston, Mass, 418 pp. Illust. The C. V. Mosby Company, St. Louis, Mo., 1959. \$12.00.

Dr. Smith, chief anæsthesiologist of the Boston Children's Hospital, has tried in this volume to gather and organize all recent information relating to pædiatric anæsthesia. As such, the book is of particular value for all those taking postgraduate training in anæsthesia and for all practitioners who may anæsthetize children from time to time.

Many chapters are especially informative, such as those on respiratory physiology, fluid therapy and blood replacement.

Unfortunately, halothane (Fluothane) has only been noted briefly, but adequate references are available.

CHIRURGIE DER HAND. ATLAS DER OPEFTATIONSTECHNIK (Surgery of the Hand. Atlas of Operative Technique). M. Iselin (Corsultant Surgeon, American Hospitals, Paris', Luc Gosse, Serge Boussard and Daniel Benois 325 pp. Illust. Georg Thieme Verlag, Stuttgar, W. Germany; Intercontinental Medical Bock Corporation, New York, 1959. DM 69.-

Dr. Iselin's book *Chirurgie de la main* was first published 30 years ago, and this present edition is a new effort to present the surgic. I

treatment of the hand in atlas form. Fractures, infection, injuries, congenital malformations and injuries to tendons are illustrated by actual cases operated on and followed up by the author. As most of the pathological conditions may lead to disabilities, the extensive and lucid chapter on reconstructive surgery is one of the most valuable and useful parts of this book. The drawings are simple and clear, and the explanatory notes are short and authoritative and conveniently placed on the opposite page.

The book would be a unique and useful addition to the library of any surgeon interested in the intriguing problems a hand injury may

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Clinical Applications of Diagnostic AND THERAPEUTIC NERVE BLOCKS, John Bonica. 354 pp. Illust, Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959. \$9.50.

The author, Dr. John J. Bonica, is recognized as an international authority on the application of regional nerve block procedures, and has already written a very comprehensive exposition of this subject. The present monograph is a well written, concise description of the most important aspects of diagnostic and therapeutic nerve blocks. It is divided into two parts. The first part begins with an interesting historical outline of the subject and a clear description of the basic neurophysiology and pathology of pain, followed by the indications for nerve blocks and the principles and requisites for optimal results. An up-to-date outline of techniques, drugs, precautions and complications expected is also included. The remaining part deals with a thorough review of the clinical application of diagnostic and therapeutic nerve blocks. Chapter Nine, which deals with blocks of sympathetic and other autonomic nerves, is particularly well done.

The author has succeeded in placing this method of diagnosis and therapy in its proper perspective so that it will be applied properly to provide patients with the maximum benefit.

The descriptions and figures are easy to follow, the print is large, the format is pleasant and the advice offered is sound. The book contains a complete table of contents, index and list of basic references. This book should find wide usefulness among anæsthetists, surgeons, and other physicians who wish to undertake diagnostic and therapeutic nerve blocks.

HANDBUCH DER ORTHOPÆDIE, Band II. Spezielle Orthopædie Rumpf (Wirbelsaeule und Becken), Handbook of Orthopædics, Vol. II. Special Orthopædics: Trunk (Vertebral Column and Pelvis), G. Hohmann, M. Hackenbroch and K. Lindemann. 1136 pp. Illust. Georg Thieme Verlag, Stuttgart, W. Germany; Intercontinental Medical Book Corporation, New York, 1958. \$41.45.

The special field covered in this book is the spinal column, pelvis, and shoulder region. The contrasting presentation of normal and

abnormal anatomy and function makes this large volume both interesting and readable. The importance of embryology is freely recognized in many of the chapters and shown to be a great help to get a clear picture of congenital deformities and their variations.

The treatment of scoliosis, a difficult subject, is thoroughly presented by Prof. Lindemann, every worthwhile conservative and operative treatment being given adequate recognition. There are excellent chapters on fractures, degenerative, and inflammatory diseases of the spinal column. Other interesting monographs are the ones on neurological complications following congenital deformities, accident diagnosis and treatment, and the forensic implications of spinal injuries; there is also a short but original chapter on gynæcological orthopædics.

It is a very difficult task not to mention the many worthy contributions—they are all authoritative and excellently presented. This volume, like the first, is a magnificent contribution to orthopædic surgery, and will serve surgeons for many years to come as a depend-

able source of information.

HERNIA. Sir Heneage Ogilvie, Consulting Surgeon, Guy's Hospital, London, England. 135 pp. Illust. Edward Arnold (Publishers) Ltd., London; The Macmillan Company of Canada Limited, Toronto, 1959. \$4.75.

There has been much writing and lecturing and debate on the subject of hernia; more articles and more controversy and instruction than perhaps on any other surgical subject, and over a longer period of time. Since herniorrhaphy is probably the most common operation performed, one might expect an even longer volume of literature on the subject. This book, by an eminent London surgeon, whose busy life in a great teaching hospital and in two World Wars, whose study of the anatomy and physiology of the inguinal region has been life-long, and whose travels and publications have been so extensive, will be appreciated very widely indeed. Ogilvie's writing is easy to read; his ideas are thoughtful, stimulating, often unorthodox. This small volume lives up to every expectation. If the reader disagrees or finds his techniques on the author's unapproved list, he cannot help but be stimulated and review his fundamental concepts, for there is nothing stated without reason leavened by experience.

Highly recommended for neophyte as well as experienced students of surgery.

PEDIATRIC NEUROSURGERY, Edited by Ira J. Jackson and Raymond K. Thompson. 564 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959, \$18.25.

It must be difficult for an editor (or author) to know where to draw the line that separates (Continued on next page)

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pædiatric from adult neurosurgery; the attempt has not been entirely successful here. Perhaps neurosurgery of childhood should not be treated as a special subject at all unless it be confined to neurosurgical ailments peculiar to childhood. This is not the scheme that has been followed consistently. It is true that the practice of neurosurgery in children calls for specialized knowledge and modified techniques and this more general aspect has been considered in the first section of the book, but there is much that cannot fairly be said to be strictly within a pædiatric surgeon's province. To take an extreme example, there is a short chapter on psychosurgery which concludes, rightly, that the type of ablative procedures used in adult mental disease has no place in the treatment of children.

In general the teaching of its pages is acceptable, the chapters on tumours (Lyle French) and congenital anomalies (William F. Meacham) being particularly good. Some authors show such a painful respect for the other point of view that one longs for the traditional dogmatism of a text book.

Opposite the dedication to Sir Geoffrey Jefferson and W. V. Cone, the publishers have inserted an unfortunate little advertisement in favour of all Thomas books, which must have distressed the editors when they saw it in the finished product.

SURGICAL TECHNIQUE. Stephen Power, Dreadnought Hospital, Greenwich, England. 411 pp. Illust. 2nd ed. William Heinemann Medical Books Ltd., London, England; British Book Service (Canada) Ltd., Toronto, 1959. \$7.20.

Intended for house surgeons, this handy book covers a great many details in surgical technique that are seldom talked or written about. The practising surgeon takes for granted such subjects as the incision, the positioning of the patient, tying knots, choice of instruments and sutures, drains, methods of dissection, and scrubbing. He seldom teaches these things and criticizes his surgeon-pupils only when he notices their mistakes, for they are things that have become almost instinctive. No one could write such a book of detailed instruction which would be completely approved by every experienced and capable surgeon, but there is no doubt that all will be stimulated and will agree that there is a place for such fundamental instruction. The second edition has been extensively revised, especially adding discussions of catheter drainage, transfusion and certain instruments. It is easy and interesting reading.

Power's Surgical Technique is recommended for every beginner in surgery and will be interesting to many of their teachers. It is possible to become a F.R.C.S. and know a great deal about operations and little about operating. A SYSTEM OF ORTHOPÆDICS AND FR. C. TURES, A. Craham Apley. 357 pp. (index 20 pp.). Butterworth & Co. (Publishers) Ltd., L. n. don, England; Butterworth & Co. (Canada) L. d., Toronto, 1959, \$9.50, Interleaved ed. \$13.56.

This small, concise manual is a compilation and amplification of lecture notes prepared or F.R.C.S. candidates studying at Pyrford. Its brevity and unambiguous verbal descripting would make it a useful work to supplement other more complete references or for quick pre-examination reviews. It could, in addition, be well recommended for study purposes or undergraduate students or any doctor handling orthopædic cases. Its form of presentation should encourage the student in developing a good routine of methodical approach.

The chapter on diagnosis contains a wealth of material by which the patient can be assessed initially. Pointing out that the common symptoms in orthopædics fall into three groups, i.e. (a) that something looks wrong; (b) that something feels wrong; (c) that movement is wrong, the author continually stresses the sequence of "LOOK, FEEL, MOVE", in examination of various disorders.

Insufficient attention has been given to osteomyelitis, especially the pattern of those cases seen in the pre-antibiotic era and in point of fact occasionally even today. The same criticism applies to the section on rheumatoid arthritis where little concrete or factual information is to be found. On the other hand, the reviewer is impressed by how comprehensively the subject of osteoarthritis and the various forms of osteochondritis have been considered. Brief but adequate descriptions are given of the clinical, pathological, and x-ray features of many of the more common dystrophies, dysplasias, and tumorous conditions of bone.

The notes on symptoms, signs and especially pathomechanics of the various balanced and unbalanced paralyses of poliomyelitis are well analyzed and should make interesting reading for even an internist. In a review of this nature it would be impractical to comment on all the topics covered but the comprehensive coverage of the subject that the author has attained is truly remarkable. Many orthopædic conditions are classified on a regional basis and although in some cases the consideration is very brief, if will serve to call to the reader's attention conditions on which he might like to refer to another source of reference.

The section on fractures is by no means an exhaustive one but again, many types are considered and even a surgeon who has done a considerable amount of this work will indoubtedly glean some useful information. This is true of the entire book which is indeed a valuable and ready source of many useful facts and would be well worth the price if only kept on the book-shelf as quick reference for the busy practitioner.

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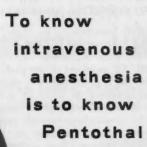
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## Books Received

Books are acknowledged as received, but in some cases reviews will also be made in later issues.

Arterial Embolism in the Limbs, The Clinical Problem and its Anatomical Basis, A. L. Jacobs, Physician to the Whittington Hospital, London, England. 200 pp. Illust, E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Coripany of Canada Limited, Toronto, 1959. 86.0.

Atlas de Techniques Chirurgicales: Les grandes teclniques: cou, thorax, abdomen, chirurgie pelvier ne. R. Michel-Bechet. 580 pp. Illust. G. Doin et Cie, Paris, 1958. 25,000 fr.

Autogenous Vein Grafts and related aspects of per pheral arterial disease. W. Andrew Dale, Assistant Professor of Clinical Surgery, Vanderbilt University School of Medicine, Preface by Earle B. Mahoney, University of Rochester School of Medicine and Dentistry, 123 pp. Illust, Charles C Themas, Springfield, Ill.; The Ryerson Press, Toronto, 1959, \$6.50.

Chirurgie du Rachis. A. Sicard, Professor at the Faculty of Medicine, Paris, 484 pp. Illust, Masson et Cie, Paris, France. Paper bound 6000 fr., linen bound 7000 fr.

Clinical Orthopædics No. 13: The Hand—Part I. Editor-in-Chief, Anthony F. DePalma. 393 pp. Illust. J. B. Lippincott Company, Philadelphia and Montreal, 1959.

Clinical Prosthetics for Physicians and Therapists. A Handbook of Clinical Practices Related to Artificial Limbs. Miles H. Anderson, Prosthetics Education Project; Charles O. Bechtol, Professor of Surgery (Orthopedics); Raymond E. Sollars, Associate Director Prosthetics Education Project, University of California. 393 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959. \$11.50.

Diseases of the Nose, Throat and Ear. A Handbook for Students and Practitioners. I. Simson Hall, Lecturer in Diseases of Nose, Throat and Ear, University of Edinburgh. 467 pp. Illust. 7th ed. E. & S. Livingstone Ltd., Edinburgh and London., The Macmillan Company of Canada Limited, Toronto, 1959. \$3.60.

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The Foot and Ankle. Their Injuries, Diseases, Deformities and Disabilities. Philip Lewin, Professor Emeritus of Bone and Joint Surgery, and formerly Head of Department, Northwestern University Medical School. 612 pp. Illust, 4th ed. Lea & Febiger, Philadelphia; The Macmillan Company of Canada Limited, Toronto, 1959. 814.00.

Lectures on the Interpretation of Pain in Orthopedic Practice. Arthur Steindler, Professor Emeritus, Orthopedic Surgery, State University of Iowa Medical School. 733 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959. \$20.25.

Neoplastic Disease at Various Sites. General Editor, D. W. Smithers. Volume II—Tumours of the Bladder, Edited by David M. Wallace, London, England. 352 pp. Illust. E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Company of Canada Limited, Toronto, 1959. \$10.25.

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Nouvelle Pratique Chirurgicale Illustrée Fascicule XIII (New Surgical Practice Illustrated, Fascicle XIII). Edited by Jean Quénu. 276 pp. Illust. G. Doin et Cie, Paris, 1959. 3,350 fr.

Peripheral Facial Palsy, pathology and surgery. Karsten Kettel, Chief Surgeon, Department of Oto-laryngology, Frederiksborg Central Hospital, Hillerod, Denmark. With a foreword by Terence Cawthorne, F.R.C.S., England. 341 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959, \$23.50.

Les Plaies de la Main (Hand Injuries). R. Souquet and A.-R. Chancholle, Toulouse. 295 pp. Illust. G. Doin et Cie, Paris, 1959. 3,600 fr.

Prosthetic Principles—Above Knee Amputations. Miles H. Anderson, Director, Prosthetics Education Project, School of Medicine, University of California; John J. Bray, Associate Research Prosthetist, School of Medicine, University of California, and Charles A. Hennessy, Associate Director, Prosthetics Education Project, School of Medicine, University of California. 331 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1960. \$11.00.

Radiation Biology. Proceedings of the Second Australasian Conference on Radiation Biology held at the University of Melbourne, 15-18 December, 1958 by the Australian Radiation Society. Edited by J. H. Martin. 304 pp. Illust. Butterworths Scientific Publications, London; Butterworth & Co. (Canada) Ltd., Toronto, 1959, \$11.00. Surgical Aspects of Medicine. H. D. Johnson, Examiner in Surgery for L.D.S., Royal Colleg, of Surgeons of England, 382 pp. Butterworth & Company (Canada) Limited, Toronto, 1959, \$13.00,

Surgical Treatment of Bone and Joint Tuber culosis. Robert Roaf, Department of Orthopa dic Surgery, Liverpool; W. H. Kirkaldy-Willis, Orthopædic Centre, Nairobi, Kenya; and A. J. M. Cathro, Orthopædic Centre, Nairobi. 137 pp. Illust. E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Company of Canada Limited, Toronto, 1959. \$5.00.

The Surgical Treatment of Scoliosis. Louis A. Goldstein, Associate Clinical Professor of Orthopædic Surgery, University of Rochester Medical Center. Appendix: Anesthesia in Scoliosis, D. Vernon Thomas, Anesthetist-in-Chief, Strong Memorial Hospital of the University of Rochester Medical Center. 96 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959, \$7.50.

A Textbook of Surgical Physiology. R. Ainslie Jamieson, Surgeon, Vale of Leven Hospital, Alexandria, Dumbartonshire, and Andrew W. Kay, Professor of Surgery, University of Sheffield. 623 pp. Illust. E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Company of Canada Limited, Toronto, 1959, \$9.35.

The Treatment of Bronchial Neoplasms. Robert R. Shaw and Donald L. Paulson, with a chapter on Bronchial adenoma by John Lester Kee, Jr. 135 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959. \$8.75.



# OPERATIVE SURGERY

General Editors: CHARLES ROB, M.C., M.Chir., F.R.C.S., Professor of Surgery, St. Mary's Hospital, London, and RODNEY SMITH, M.S., F.R.C.S., Surgeon, St. George's Hospital, London.

This work which was originally published as a complete set of eight volumes and index has now been specially edited and divided into groups shown below. Each volume contains its own index and in the case of sets of volumes, there is a comprehensive index to the whole set.

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CANCER OF THE BREAST. Willard H. Parsons, ditor. 232 pp. Illust. Charles C Thomas, Springfield, Illinois; The Ryerson Press, Toronto, 959, \$8.25.

This monograph is the product of twelve contributors, each well-known and most capab e in his own sphere. Its ten chapters undertale to bring us up to date in clear and concise form on the varied aspects of cancer of the breast as they have for some time been discussed. The foreword by Dr. Warren Cole reviews the several chapters. In the final chapter under the title "Present status of carcer of the breast" Dr. Parsons presents something of the differences of thought which ob ain among workers in this field and an effort to introduce reason between them. He apparently finds the McWhirter philosophy as difficult to digest as the reviewer has done, and he uses considerable space to indicate that difficulty. He does not seem to know how good is the company he keeps, and that at Edin-burgh last summer the McWhirter philosophy which was coming to be called the "Edinburgh Method"-was virtually repudiated publicly by Edinburgh in his own department, as having been a worthwhile-enough experiment, but no longer favoured in his hospital and university.

In the chapter on simple mastectomy by Dr. Byrd, one finds the acceptance of a practice which will not be found agreeable to many surgeons of experience on this continent.

The reviewer was especially happy with the chapter on surgical pathology by Dr. Foote, and trapped his senior pathologist into reading it too. For a pathologist, he was agreeably enthusiastic. His summary was "It is the most significant attempt in recent years to explain breast pathology to the surgeon and the breast surgeon to pathology". We agree.

surgeon to pathology". We agree. Radiation therapy is covered by Dr. Pendergast with knowledge and restraint, out of wide

experience.

Two sections left us unhappy: (1) the surgical: (a) as under simple mastectomy above and (b) as an extension of (a) having respect more specifically to simple mastectomy in stages III and IV. So many patients have been made rapidly worse by the procedure, and there are such better ways of treating them, that there will be strong objection to any but the rarest application of surgery to these conditions. (2) Chemotherapy: Because to this department we look with more hope than to any other in stages III and IV cancer of the breast, anything related to it is read with avidity. In this book hormone therapy is discussed together with the ablation of the different glands, including the hypophysis and the adrenals. The author comes down on the side of adrenalectomy, and the case for hypophysectomy is not made at all. As between the two an excellent case can be made for the latter,

especially by those centres in which mortality in hypophysectomy is very low. This however is now academic or it bids fair to be if Nissen-Meyer's work (Oslo 1958) on "medical hypophysectomy"-or as it may in fact be "medical adrenalectomy"-continues to show as good results as do the more serious operative procedures of hypophysectomy and adrenalectomy. Our observation in its short use here (one and one-half years) is that its primary results are equally good as those obtained in hypophysectomy when so employed. Since however the agent employed as substitute for ablation is the same, and in the same dose, as is employed as maintenance in hypophysectomy, the question must be posed as to whether it was the surgical procedure that gave the good results or the "replacement" therapy that followed it. If the latter produces the results as seems to be the case, is hypophysectomy or adrenalectomy ever indicated?

The compiler makes no pretence at being encyclopædic. Yet in very small compass he has produced a stimulating treatise in which there can be no monotony because of the irregular alternation of the parts that delight and parts with which readers may sharply

disagree.

For seminar discussions, it could be recommended to medical students as having much that is edifying but also because of its value as an exercise in sifting chaff from some very excellent wheat.

TRAITE DE TECHNIQUE CHIRURGICALE (Treatise of Surgical Techniques). B. Fey, P. Mocquot, S. Oberlin and others. 761 pp. Illust. 2nd ed. Masson et Cie, Paris, 1959. Paper 6.000 fr., cloth 7.200 fr.

Ce livre se lit avec beaucoup d'intérêt car il est précis et bien écrit. Les auteurs ne se perdent pas en explications longues et fastidieuses pour le lecteur. Pour chaque opération, différentes techniques sont proposées, discutées brièvement et bien illustrées. Le lecteur pourra puiser ailleurs les statistiques sur la valeur de chacun de ces procédés s'il le désire.

Ce traité présente d'autres avantages; il donne un résumé succinct de l'historique de la technique, ce qui ajoute de l'intérêt. De plus, il contient quelques données su l'anatomie et la physiologie de chaque organe étudié. Les soins pré et post-opératoires spécifiques sont esquissés rapidement et enfin les complications majeures, se rapportant à chaque opération, sont énumérées et quelques explications sur les moyens à prendre pour les éviter et les traiter y sont données.

Si les autres tomes de ce traité sont présentés avec la même précision et la même sobriété, il devrait être recommandé à tous les jeunes chirurgiens pour consultation de tous les jours. TO CONTROL BLEEDING FROM THE CAPILLARY BED

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# HISTORY OF CANADIAN SURGERY

#### MANITOBA SURGICAL PIONEERS

JAMES KERR (1849 - 1911) and H. H. CHOWN (1859 - 1944)

ROSS MITCHELL, M.D., Winnipeg

In the making of a true surgeon thorough preparation is essential. The founders of a true medical school must be equally well prepared in training and in character. They m ist be men we'l skilled in their profession ard possessed of high ideals and business acumen. James Kerr and Henry Havelock Cown had these qualifications. They deserve to be remembered not only for their surgical skill but also for the ideals which in pelled them to found and administer, ui der adverse conditions, a medical school in a new province just being opened to in migration. Both men were young, well truined, adventurous and idealistic when they set about their task, and happily both met with success. In Pasteur's phrase, fortune favoured the prepared mind.

James Kerr was born at Port Stewart, County Antrim, Ireland in 1849, and studied medicine at Queen's University, Belfast. In his final year he was house surgeon under Sir William MacCormac who made a name for himself as a military surgeon in the Franco-Prussian and Turco-Serbian wars. MacCormac was one of the first to apply Lister's principles to the surgery of joints and abdomen and his instruction was not lost on the young intern.

Graduating in 1870, Kerr practised briefly in one of the hunting shires of England until, lured by adventure, he sailed to the Ashanti war on the Gold Coast in 1873 as surgeon to the 42nd Highlanders, "The Gallant Black Watch". On the way Kerr and an officer were watching a school of sharks following the steamship. The officer remarked that a man overboard would stand no chance. Kerr contended that sharks never attack an uninjured man. Other officers joining in, the discussion became more heated until Kerr dived in, swam among the sharks and was picked up unharmed.

Life as a ship's surgeon appealed to him and he made several trips to Canada in Allan liners. On one voyage he made the acquaintance of Miss Laura Jane Bell, a



Dr. James Kerr.

charming young lady travelling with her parents to Canada, and they became engaged. In 1875 he started practice at Londonderry, Nova Scotia, where there were iron mines, and the original settlers had come from the north of Ireland. Kerr was appointed surgeon to the Steel Company of Canada, and with his future thus assured, he married his sweetheart in Brantford at the home of her cousin, Alexander Graham Bell. It is interesting that their marriage was at the very time and place of Bell's first message over the telephone. Best man at the wedding was a young Montreal doctor, William Osler. honeymoon was spent at Philadelphia where the Centennial Exposition was in full swing. There the young couple heard Mr. Lister give his first address in America on antiseptic surgery. Alas, his message

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for the most part fell on deaf ears but the young Irishman drank in every word and was confirmed in his belief in the truth of Lister's teaching.

This teaching, so new and different, was not universally accepted. England at first stood aloof but Germany welcomed it. In order to see the practical application of Lister's principles, Kerr and a like-minded young surgeon, possibly Francis Shepherd of Montreal, visited German hospitals and were more firmly convinced. On his return to Canada, Kerr practised these principles with success. Word of his ability filtered out and he received an invitation to join the medical faculty of McGill. He went with his wife and two young children to Montreal, and ere long was appointed Chief Surgeon of the Canadian Pacific Railway, then building westward. On a trip to the new province of Manitoba he was impressed with the possibilities of Winnipeg, "loosely jointed, gawky, boisterous and mud-bespattered, but alive with the first flush of youth", already a city in name but with only 20,000 inhabitants, mostly newcomers. Kerr chose a site for a tuberculosis sanatorium at Banff Springs, and so helped to start Banff as a resort. Kerr was appointed health officer for the province and travelled through it to enforce vaccination. Recognizing the danger of the Red River as the almost universal source of drinking water, he arranged for the sinking of a well near the General Hospital in the west end of the city. By good fortune it proved to be Winnipeg's first artesian well, and for many years it served the hospital and vicinity.

Continuing to practise antiseptic surgery, Kerr had such success that the other doctors of the city accepted him as leader. When a young medical man fresh from postgraduate studies overseas and a son of the lieutenant-governor of the province came with the avowed intention of starting a proprietary medical school, the Winnipeg doctors met to discuss the situation. Dr. Kerr declared that before a medical school could be started in Manitoba, it must meet two conditions:

1. It must be the co-operative effort of the established doctors.

2. It must be affiliated with the Uni-

versity of Manitoba and accept ts standards.

Thirteen incorporators, including Provincial Secretary, Dr. D. H. Wilson, obtained a charter from the provincial gevernment in September, 1883. At this point the incorporators were disposed to rest. for they were not convinced that the time was ripe or that the instruction would be efficient. However, a few days later a group of would-be medical students and some who had had a year or two of training elsewhere met and passed a resolution urging that the school be started. The incorporators, mostly in their early thirties, caught the spark and on the evening of November 15, 1883, the newly chosen Dean, Dr. Kerr, delivered the inaugural address in rooms at the corner of Main and Portage. Among his words were these "What would be premature and impossible in older countries becomes here justified and even necessary".

Classes began at eight o'clock the next morning in a cottage on Harriet Street and in rooms in the Central School. The following year the faculty secured a mortgage of \$4000 at 9% interest on land near the General Hospital—tight money in those days—and in 1885 a two storey brick and stone building was erected. At about this time the General Hospital had moved into new brick buildings making it the finest hospital in the Canadian west. Wards A and B of this structure have recently been torn down to make way for a modern unit.

When the North West rebellion broke out in March 1885, Dr. Kerr was appointed Surgeon-Major in the Medical Corps, and the Winnipeg General Hospital was named the base hospital. Dr. Kerr was surgeon, and young Dr. F. H. Mewburn was assistant. The Surgeon-General, Dr. Thomas Roddick, arranged that the per diem rate for military sick and wounded should be \$1.50 and the base hospital continued on this financial arrangement until the discharge of the last patient in the mid lle of 1886. The annual report of the Wirnipeg General Hospital for that year records that Dr. Kerr had done three major operations on soldiers; incision and drainage of an empyema, excision of a large hydrocele of the neck in contact with the carctid

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sheath and subclavian artery, and incision of a knee joint with extraction of a bullet. All ran an aseptic course and resulted in complete cures. Mewburn became the first P of essor of Surgery in the University of A berta in 1906.

During the campaign which lasted from Narch to May 1885, Kerr made a two week trip to the front lines with Roddick and James Bell of Montreal. Kerr suffered an acute attack of nephritis and rl eumatism, brought on by icy winds and iclting buckboards, and with his health tl us undermined he left Winnipeg in 1887. Before doing so he reduced successfully an intussusception in the young son of a colleague after medical measures by other doctors had failed. At that time surgical intervention for this condition was a most daring procedure.

Kerr was then offered the post of chief surgeon at the Johns Hopkins Hospital at Baltimore but found so many restrictions placed on his activities that he declined. He moved to Washington, D.C., where he attracted a group of surgical disciples and soon was appointed to the chair of surgery in one of the two medical schools in that city. He resigned to become Professor of Surgery in Georgetown University and later at the George Washington University. He had several "firsts" to his credit in the Washington district; first cholecystectomy, first gasserian ganglion operation, and first operation for intussusception.

He resigned in 1894 because of failing health, but continued in private practice, honoured and esteemed. At his summer home in Virginia, his love of fine horses led him to breed steeplechase racers, for jumping ability as well as speed. He died in 1911 at Warrenton, Va. His portrait hangs in the office of the Dean in Winnipeg's

Medical School.

#### DR. HENRY H. CHOWN

Unlike James Kerr, H. H. Chown was a second generation Canadian. His paternal grandparents came from Devonshire, England, to Canada in the sailing ship "General Wolfe" in 1832, and made Kingston their home. The eldest son, Edwin, father of Henry, became a well-to-do manufacturer and a pillar of Sydenham Methodist



Dr. Henry H. Chown.

Church. Other Chowns made their mark in business, at Queen's University and in the Methodist Church of Canada.

Henry Chown was born on February 16, 1859, and was educated in Kingston schools, Victoria College (then at Cobourg) where he obtained the B.A. degree, and Queen's University, graduating M.D. in 1880.

The opening up of railway communication with "the last great west" brought a rush of adventurers to Winnipeg, among them this young doctor. After two years of practice in the new city he sailed on the Allan line "Peruvian" to London and enrolled as a clinical clerk at The London Hospital Medical School in Whitechapel. It boasted a distinguished group of teachers: Sir Andrew Clark, Queen Victoria's physician, Frederick Treves, who later operated on the Prince of Wales for perityphlitis, Morrell Mackenzie, the laryngologist who attended Emperor Frederick of Germany, Hughlings Jackson the neurologist, Jonathan Hutchinson, Harry Fenwick the urologist, and George Ernest Herman of "Difficult Labour". One day Chown went to King's College Hospital to see Lister. An entry in his diary for June 8, 1882 runs a description of Lister "a fine gentlemanly, well built man, full face, white side whiskers and hair turning grey -only a poor operator, removal of the tongue for cancer". On July 12 at the Samaritan Hospital he noticed among those gathered to see an operation for removal of a fibroid uterus with a four month fetus, Robert Emmett of New York-"middle aged gentleman, cool and quiet looking".

When he returned to Winnipeg the chief topic was the proposed medical school. Chown thought that the project was premature and declined to be one of the incorporators, but by 1885 he was teaching anatomy. Thus began a connection with Manitoba Medical College which lasted until 1917. He turned to teaching surgery and soon was made Professor of Clinical Surgery. When that most remarkable character, Dr. J. W. Good hit the trail of '98 for the Yukon, Dr. Chown was appointed

the third Dean.

Though he was a brilliant operator, his greatest achievement lay in the field of medical education. During his deanship, there occurred the move of the Medical College to a new building on the present site immediately west of the General Hospital, the creation of a pre-medical course with emphasis on science, the appointment of the first full-time professor, and in 1917 the change whereby Manitoba Medical College became the Faculty of Medicine of the University of Manitoba. The property and equipment of the College, valued at \$250,000 were turned over, free of debt, to the University. Dr. Chown had represented the College on the old University Council; he now became a member of the first Board of Governors and resigned as Dean.

Dr. Chown's connection with the Winnipeg General Hospital lasted also for 32 years. He read widely and well and was a daring and expert surgeon, always a little in advance of his confrères. The house staff almost fought to be on his service, though it meant early rising as the Chief felt freshest in the early morning and would have started at six if hospital rules permitted. Though rubber gloves were coming into use on Halsted's suggestion, Chown never wore them as he thought they impaired his sense of touch, but hs hands were gentle, quick and skillful. Fe confided that he never approached a diff cult or dangerous operation without reacing all the details an hour or two before

going to the hospital.

At a time when a distinguished physicia 1 in England said "ovariotomy is not sugery, it is murder", a woman went to Chown with a large ovarian cyst which made her life a burden. At his own espense he had her placed in a private room, bought fresh linen for the bed, then triumphantly removed the cyst without infection. It was the first ovariotomy in western Canada. Also to his credit was the first gastroenterostomy in this region. News of the latter operation reached the ears of the Governor-General, then visiting Winnipeg, and at a dinner in Government House, he requested Dr. Chown to draw a diagram of what he had done. It was an anterior gastroenterostomy. When the annual meeting of the Canadian Medical Association was held at Winnipeg in 1901, he operated before his colleagues to remove a hydatid cyst of the liver, a condition not infrequently found in the early Icelandic settlers in Manitoba, but seldom encountered by Eastern visitors.

After his marriage to Kate Farrell, a lady of charm and humour, Chown lived first at the corner of Donald and Ellice Streets, and later at 263 Broadway near his beloved Manitoba Club. After his wife's death in 1916 he was cared for by a Chinese manservant. His elder son, Charles, died in early manhood, his second son Dr. H. Bruce Chown, is internationally known as a serologist. The late Dr. Gordon Chown, whose name is associated with the Children's Hospital in Winnipeg, was 1 nephew, and Gordon Chown, M.P. fcr Winnipeg South, is a grand nephew.

In his early years Dr. Chown real widely in Western Canada's history, an l on September 17, 1915 he was persuade l to read before the Winnipeg Medical Society, a paper on "Medical Men and Medicine in Western Canada".

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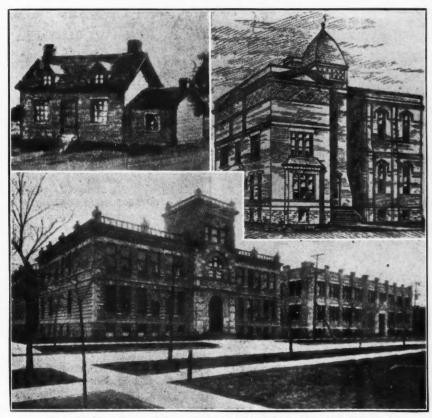
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(Left) Building first used for anatomy in 1883. (Right) The old Medical College on Kate Street. This building still stands on the corner of Kate Street and McDermot Avenue. (Bottom) Manitoba Medical College as it appears today.

Company was formed in Winnipeg, Dr. Chown was a charter member. On his retirement from active practice he and his friend, Dr. R. J. Blanchard, were the first medical referees of the company.

In 1903, Queen's University, his Alma Mater, conferred on Dr. Chown the LL.D. degree, an honour which he prized highly. On the 60th anniversary of the University of Manitoba, his name was proposed for the same degree but he declined on the ground that one such honour was sufficient.

His later years were spent largely in travel, usually by air. In a humidor presented to him by the Ontario delegation in 1911, is his passport with visas from Japan, China, Brazil, Argentine, Chile, Palestine, Egypt, France, Monaco, Colom-

bia, Ecuador, Peru and Mexico. He maintained a lively interest in men and affairs until he died on October 12, 1944.

In all ranks of life Dr. Chown had many warm friends for he "did good by stealth". He was the prototype of Dr. Towne in "The Viking Heart" by Laura Salverson, and her "Confessions of an Immigrant's Daughter" was dedicated to him for his devotion to the poor.

James Kerr and Henry Chown can rightly be called makers of the Canadian West.

#### ACKNOWLEDGMENT

I am indebted to the University of Manitoba for permission to reprint the illustrations of this article; they were first published in the *Manitoba Medical Journal*, Vol. 5, 1933.

# ORIGINAL ARTICLES

# CESOPHAGEAL STRICTURE SECONDARY TO HIATUS HERNIA IN THE AGED

ERIC M. NANSON, M.B., Ch.B.(N.Z.), F.R.C.S.(Eng.), F.R.C.S.[C], F.A.C.S., Saskatoon

It is well known that æsophageal stricture may develop from reflux æsophagitis secondary to the sliding type of hiatus hernia. Belsey¹ and Robb² have drawn attention to this condition in infants. Allison,³ Barrett,⁴ MacLean and Wangensteen⁵ and others have discused it in adults.<sup>6-10</sup> Little attention has, however, been given the condition when it comes on in the aged.

The importance of inflammatory stricture secondary to hiatus hernia in a person over the age of 60 years is that it may develop insidiously. The patient will then report to his doctor with a history of progressive dysphagia over a few weeks or months, without any significant antecedent history of esophageal reflux indicative of hiatus hernia.

As a result of this history, carcinoma of the lower œsophagus is suspected. Barium swallow will show an irregular narrowing of the lower œsophagus, and frequently no hiatus hernia will be demonstrated. The radiologist, influenced by the patient's age and the appearance of the lesion, will probably report a lesion suggestive of carcinoma of the lower œsophagus.

The œsophagoscopist will see a stricture at the lower end of the œsophagus and will take a biopsy from above it. The pathologist will report chronic œsophagitis, and the clinician in charge of the patient will assume that the patient has a carcinoma of the œsophagus, that the biopsy was taken from above the lesion, and so request a further œsophagoscopy. The result will again be the same, therefore, on clinical grounds, the case will be labelled a carcinoma of œsophagus. Then, because of the age of the patient, which is likely to be 70 years or more, surgical excision is unlikely to be considered, and so irradiation will be employed. The patient, however, will neither improve nor die. Therefore a second look will be taken at the patient, and perhaps the correct diagnosis will ultimately be made. Alternatively, in somewhat younger patient of perhaps 6 years, an esophogastrectomy will be performed and the true nature of the lesion be discovered. Unfortunately, such an operation may set up a further cycle of changes beginning with esophageal reflux and ending with another stricture. Therefore an appreciation of this condition in the aged is important. Furthermore, a knowledge of the method of arriving at a sure diagnosis, and the simple method of treating it should be known.

Since 1955 four men and four women, all elderly patients with stricture secondary to hiatus hernia have been seen in the University Hospital, Saskatoon. The first of these provided an interesting story, and drew attention to this problem.

#### CASE HISTORY

For a few months before admission to the University Hospital on September 20, 1955, an elderly white man whose biological age matched his chronological age of 83, had complained of epigastric pain for which he was taking alkaline powders. During the two weeks before admission he had been unable to swallow solid food because it "stuck" behind his lower sternum.

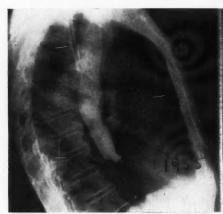


Fig. 1.—Patient aged 83 years. Appearance c lower esophagus when first seen was strongl suggestive of carcinoma.

<sup>&</sup>lt;sup>o</sup>Department of Surgery, University of Saskatchewan, Saskatoon.

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A barium swallow showed a narrowing of the lower end of the œsophagus extending from the 10th thoracic vertebra down to the cardia (Fig. 1). The radiologist stated that this was undoubtedly a carcinoma of œsophagus. An œsophagoscopy showed a stricture at 30 cri. from the upper incisor teeth, and a m icosa which appeared pearly pink. A biopsy taken from above the stricture came back with the inevitable pathological report of chronic œ ophagitis. Because the clinical diagnosis was carcinoma of the œsophagus, the patient was gi en radiotherapy of 6000r spread over five weeks (Fig. 2). At the end of this time the ra liological appearance had not changed, nor was the patient's swallowing any better. Accordingly, on February 7, 1956, a further œsophagoscopy was carried out. The stricture was dilated up to 28F. size, and a biopsy was taken from inside the strictured area. This was reported as gastric mucosa. The diagnosis was now evident. The patient had a benign lower œsophageal stricture secondary to hiatus hernia. He was further dilated up to 40F. size quite readily and a barium swallow at this stage showed clearly the hiatus hernia (Fig. 3). The patient was discharged, swallowing well, on February 15.

The further history is interesting. He was readmitted two months later, on April 24, with a left hemiplegia with which was associated difficulty in initiating the act of de-

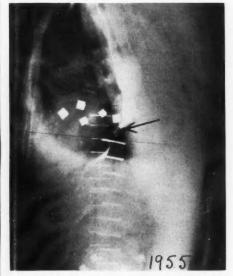


Fig. 2.—Same patient as in Fig. 1. Radiological appearance of cesophagus at time of radiation therapy. Marks on film are used by radiotherapists to control direction of cobalt 60 radiation.

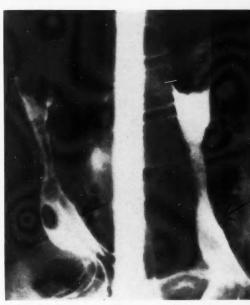


Fig. 3.—Appearance of lower œsophagus after dilatation of stricture, showing classic features of hiatus hernia.

glutition due to some degree of vagal paralysis. Being dysphagic, again he was dilated, once more to 40F. quite readily, on May 4. Six days later he had further dysphagia and vomiting. The barium swallow showed a large filling defect at the lower end of the œsophagus occupying almost the entire lumen. Again the radiologist reported that this was almost certainly due to recurrent carcinoma (Fig. 4). Another œsophagoscopy was performed and a large piece of meat was removed from above the stricture area. The stricture area was smooth with no evidence of any ulceration. Since this time he has been readmitted to hospital on four further occasions with arteriosclerotic heart disease and advancing cerebrovascular disease, which has produced a frank bulbar palsy with marked dysphagia due to vagal involvement. His œsophagus was dilated up periodically and this has enabled him to swallow soft foods reasonably well, and to continue living to the present time at the ripe old age of 87 years.

The history of this patient has been given in some detail because it typifies the story of benign stricture of the lower cesophagus secondary to hiatus hernia in the aged. Since 1956 seven further such patients have been seen in the University



Fig. 4.—Same patient as in Fig. 1. Radiological appearance of œsophagus reported a second time by radiologist as typical of fungating carcinoma. Filling defect was in fact due to a bolus of food stuck above the stricture.

Hospital, Saskatoon. The average age at which these patients came for treatment of their dysphagia was 73 years. The youngest patient was 54 years of age, a woman who had both a duodenal ulcer plus a hiatus hernia with stricture. She was treated by œsophageal dilatation followed by partial gastrectomy and repair of the hiatus hernia. The oldest patient was 83 years of age. If the patient of 54 years were removed from the series, then the average age would have been 76 years. There were four women and four men in the series.

TABLE I. — PERTINENT DETAILS OF SEVEN CASES OF BENIGN ŒSOPHAGEAL STRICTURE

Symptoms	Vague epigastric pain	3 wks. to 15 yrs
	Dysphagia Heartburn	Average of 5 yrs
Site	Lower two inches of œ	sophagus
Biopsy	Gastric mucosa below ture and above diap	stric-
Treatment	Dilatation to 38F401 medical regime	F. plus

In Table I it will be noted that the symptoms were epigastric pain, heartburn, and dysphagia varying in duration for as short a time as three weeks up to as long as 15 years. It is interesting to note that in

two patients the only symptom was d'sphagia, and in one of these it had been present for only three weeks and in he other for five years (Figs. 5 and 6). In neither of these had there been any pain. In none of the patients was any history of regurgitation elicited. Therefore, in none of these eight patients was a classic history of long standing esophageal reflux fou d. Furthermore, in none of the patients v as epigastric pain a prominent feature since it had never caused them to seek medial advice. One patient aged 72 years, had complained of dysphagia 14 years before. She had been dilated at that time and had remained symptom free until six mon hs before admission when dysphagia had gradually recurred. Another patient aged 77 years,\* had a right hemicolectomy for carcinoma of the right side of the colon two years before admission. She was admitted with an acute large bowel obstruction due to another carcinoma of the splenic flexure. This lesion was dealt with by preliminary colostomy followed by a left partial colectomy. During this period of treatment she had a Levine tube in place for eight days. Following this she had retrosternal pain, melæna and, within three weeks, developed a lower œsophageal stricture. She was found to have a hiatus hernia. This case is of interest because Bingham<sup>11</sup> has pointed out that an indwelling Levine tube in the presence of hiatus hernia may be the initiating factor in producing esophagitis with a rapidly developing stricture.

#### DIAGNOSIS

In an elderly patient with radiological evidence of lower œsophageal stricture it is important to consider the possibil ty of unsuspected hiatus hernia. An œ ophagoscopy must therefore be carried out. The stricture should be dilated sufficienly to pass biopsy forceps through it, and tissue should be obtained from within or below the stricture. If the pathologist eports this as gastric mucosa, and if it was obtained from above the diaphragm, then the diagnosis of hiatus hernia is proven

<sup>°</sup>I am indebted to Dr. R. W. Cram for this c se history.

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lig. 5.—Patient aged 82 years. Appearance of ess phagus before dilatation. Notice close resembla ice to carcinoma.

## TREATMENT

The treatment of œsophageal stricture secondary to peptic œsophagitis of hiatal hernia is unsatisfactory, as evidenced by the multitude of methods advocated. 12-16 If possible the hiatus hernia should be repaired and the competence of the cardia restored. MacLean and Wangensteen have advocated partial gastrectomy to cut down the acid secretion of the stomach and to produce free gastric drainage, leaving the



Fig. 6.—Same patient as in Fig. 5. Appearance of cesophagus after dilatation showing typical hia'us hernia and no carcinoma.

hiatus hernia undisturbed. Others have advocated œsophagogastrectomy with antrectomy of pyloroplasty.<sup>17, 18</sup> However, none of these procedures is to be recommended in this group of old age patients. Instead, the stricture should be dilated to a reasonable size, between 30F.-40F. as often as required, and a good medical regime, consisting of bland diet and antacid medication should be prescribed. Sleeping propped up at night is also to be advocated. It is noteworthy that some of these patients required only one or two dilatations to render them symptom free.

## SUMMARY

Attention is drawn to a little recognized syndrome of dysphagia in the aged with an insidious onset. This is due to an unrecognized hiatus hernia which produces reflux œsophagitis leading to inflammatory benign stricture. It is pointed out that these strictures are often mistaken for carcinoma of the lower œsophagus, and treated as such.

A typical case history is given. Eight such cases seen in the University Hospital, Saskatoon, are reported.

The diagnosis hinges upon dilatation of the stricture, the taking of a biopsy from within or below the stricture and obtaining gastric mucosa from above the diaphragm.

Treatment is conservative and consists of adequate dilatation of the stricture plus a continued medical regime of bland diet, antacid medication and sleeping propped up at night.

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## RÉSUMÉ

Cet article est basé sur l'étude de huit ca de stricture œsophagienne non cancéreuse, conséct tive à une hernie diaphragmatique. L'histoire d'un de ces cas est présentée en détail.

Un homme de 83 ans est adressé à l'Hè ital universitaire de Saskatoon pour dysphagie et douleurs épigastriques. Durant les deux sem ince qui ont précédé son admission, il a été incar ible d'avaler aucune nourriture solide. Un extenen baryté montre un rétrécissement de la partie inférieure de l'œsophage allant de la dix eme vertèbre thoracique jusqu'au cardia. Le diagn stie radiologique est celui de cancer de l'œsophage sul la discophage allant de la dix eme vertèbre thoracique jusqu'au cardia. Le diagn stie radiologique est celui de cancer de l'œsophage. L'œsophagoscopie montre le même rétrécissement et une biopsie est faite, où l'anatomopathologiste ne trouve que de l'œsophagite chronique.

Néamoins le malade est traité par la radiothérapie à raison de 6000r en cinq semaines. A la fin de cette cure, il n'y a aucun changement dans l'état du patient. Une seconde œsophagescopie est pratiquée et une biopsie ramène un fragment de muqueuse gastrique. Le diagnostic devient dès lors, évident: il s'agit d'un rétrécissement œsophagien bénin secondaire à une hernie du hiatus. Des dilatations permirent de tout remettre en ordre.

Le diagnostic de cette affection est délicat, car l'âge des malades et les découvertes radiologiques font fortement penser à un carcinome; la biopsie n'aide guère, car avec une réponse telle que "œsophagite chronique", on croit simplement avoir fait le prélèvement en dehors de la lésion. Par contre, si l'on a la chance de ramener un fragment de muqueuse gastrique, et à la condition d'être sir que celle-ci était sus-diaphragmatique, il devient difficile de se tromper.

Le traitement sera purement conservateur. On devra se contenter de soulager les phénomènes de dysphagie par la dilatation du rétrécissement et la prescription d'un régime approprié.

## THE YOUNG CHILD'S HIP°

". . . The congenitally dislocated hip has come under close study in an attempt to improve the poor long-term results which follow classical treatment by manipulations and immobilization in plaster in the 'frog' position. It is now known that the incidence of osteochondritis is reduced if the dislocation is gradually replaced using an abduction frame for reduction. Many of the anatomical changes described in the classical literature are secondary to weight-bearing on the dislocated joint and a study of anatomical material in the fœtus and infant has led to a realization of the significance of ante-version of the femoral

neck and of soft-tissue barriers in obstructing reduction. Ante-version can persist in spite of apparently successful reduction and can cause the femoral head to dislocate anteriorly. If appreciable, this deformity is now dealt with by immobilization of the reduced hip in internal rotation with later correction by osteotomy.

More insistence is now placed on exact reduction in order to achieve a joint which is congruous. If a high standard of reduction cannot be achieved by closed methods, open operation to excise the obstructing soft tissue and to replace the head is now undert ken more frequently; interim results indicate that these methods are an improvement on the somewhat more rigid techniques of old. . . ."

<sup>\*</sup>Scottish M. J., 5: 178, 1960

## ISLET-CELL TUMOURS OF THE PANCREAS\*

J. R. F. MILLS, M.D., M.S., F.R.C.S.(Edin.)[C], Toronto

ISL T-CELL TUMOURS of the pancreas are rather uncommon lesions, but they have to be considered seriously in the differential diagnosis of patients suffering from hypogly æmia. When correctly diagnosed and successfully removed, the results of treatment may be dramatic.

I angerhans first described the islets in 1869 but the first preoperative diagnosis of a hyperfunctioning tumour was made in 1957 by Wilder of the Mayo Clinic. The patient was operated upon by W. J. Mayo and a metastasizing carcinoma was found from which the patient died. It is interesting to note that this patient was a physician. The first successful removal of a tumour of the islet cells was carried out by Roscoe Graham at the Toronto General Hospital in 1929. This patient made a complete recovery. Since that time many cases have been reported in the literature.

Our series of 22 patients comprises all the known cases in the records of the Toronto General Hospital and Sunnybrook Hospital between 1929 and 1959.

Table II shows that the highest incidence was in the 30-40 year age group. The youngest in the group was a 20 year old man who had been having convulsive seizures and from whom a benign adenoma was removed. The oldest patient was 76 years of age; post-mortem revealed an asymptomatic benign adenoma.

## SYMPTOMATOLOGY

Diagnosis of this condition is often very difficult and in a small percentage of cases is made only at autopsy. In our series, symptoms relating to the central nervous system were the most commonly presenting complaint. Occasionally these were associated with gastrointestinal trouble. The commonest symptoms were loss of consciousness with or without seizures, personality changes and attacks of weakness, drowsiness, loss of memory and stupor.

One patient had been admitted to a mental hospital as an epileptic. It was noted at that time that occurrence of her attacks was related to long abstinence from food. Another patient had been on diphenylhydantoin (Dilantin) therapy for seizures. One had had fainting spells for 10 years and recently these attacks had been occurring more frequently and lasting longer. Two patients were admitted in coma. In one of them the correct diagnosis was made and an adenoma was removed with excellent results. In the other, the diagnosis was suspected and the blood sugar was found to be 43 mg. %. However, when the symptoms did not improve after administration of intravenous glucose, although the blood sugar returned to normal, the diagnosis of hyperinsulinism was abandoned in favour of encephalitis. At postmortem a 65 g. adenoma the size of a walnut was found, which was undoubtedly the cause of the patient's death.

In 15 of the 22 cases studied the symptoms of cerebral hypoglycæmia were predominant and the presenting complaints were related to this condition. In two patients the lesions discovered at postmortem were considered as incidental findings and non functioning. The remaining five patients presented with an upper abdominal mass or widespread metastatic carcinoma.

TABLE I.

Total number of patier	nts	*		,	*						22
Sex incidence: Men.			 					 			8
Women	١		 					 			14

TABLE II.—Age Incidence in a Series of 22 Cases of Islet-Cell Tumours

													No. of	patients
20 -	30	years												2
30 -	40	- 16												8
40 -	50													6
50 -	60													2
60 -	70	44											4	2
70 -	80	6.6												2

The first of the three patients with carcinoma without metastases had had a cholecystojejunostomy ten years before for

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<sup>&</sup>lt;sup>®</sup>From the Department of Surgery, University of Teronto, Toronto General Hospital and Sunny-brook Hospital.

what was presumed to be a carcinoma of the head of the pancreas. She was admitted on this occasion with symptoms due to anæmia. At operation it was impossible to remove the mass but biopsy proved it to be an islet-cell carcinoma. The second patient, a 69 year old woman, underwent a resection of the tail of the pancreas and spleen for a malignant islet-cell tumour. This is the oldest patient on record with hyperinsulinism from this type of tumour. The third patient presented with anæmia, an upper abdominal mass and steatorrhœa. At operation it was necessary to do a Whipple resection to remove a very large islet-cell carcinoma of the head of the pancreas. In one of the two patients with metastases the diagnosis was made at operation and in the other only at postmortem.

The microscopic pattern of these lesions is merely a duplication of the normal islets (Table III). Clinically 16 were considered to be functioning. The patient with a non functioning tumour presented with a 13 month history of a mass in the right upper abdominal quadrant.

TABLE III.—HISTOLOGY OF ISLET-CELL TUMOURS

	Λ	To	).	0	f	pe	at	ients
Benign adenomas: Functioning islet-cell tumours Non functioning islet-cell tumours Carcinomas: Metastacijing								16 1
Metastasizing								3

In two patients with carcinoma a biopsy and palliative procedure only were carried out. In one patient in whom a large isletcell carcinoma occupied the head of the pancreas a radical pancreaticoduodenectomy had to be performed to remove the lesion.

When a benign adenoma was found a simple enucleation was done in 13 cases. If the tumour was in the tail of the pancreas the tendency was to resect the tail including the adenoma. In two patients the surgeon could not find an adenoma at operation and decided to do a subtotal pancreatectomy removing the pancreas distal to the superior mesenteric vessels. In one of these, an adenoma was found after sectioning the resected specimen. In the

second case no tumour was found and since there was no improvement in the patient's symptoms, another explorat on was carried out. At this operation af er mobilizing the head of the pancreas in encapsulated tumour was found in it.

TABLE IV.—LOCATION OF BENIGN ADENOM.

Panc	r	0	18											No.	of pati
Head											,				5
Body															6
Tail.												į			6

In operating on patients with a suspected islet-cell tumour the easiest access to the pancreas is through a slightly curved transverse incision placed midway between the xiphoid process and the umbilicus with its convexity directed upwards.2 A complete and careful inspection and palpation of the entire pancreas is essential as multiple tumours may be present in 10% to 12% of cases. If a tumour is not readily recognized in the body and tail of the pancreas it will be necessary to mobilize the organ.3 The lesser sac is entered and the posterior parietal peritoneum inferior to the lower border of the pancreas is incised from the splenic hilus to the superior mesenteric vessels in order to reflect and palpate the body and tail of the pancreas. The head can be examined most easily by mobilizing the duodenum by the Kocher manœuvre with division of the peritoneum on the lateral side of the descending duodenum in order to turn it medially for inspection of the posterior surface of the head.

			6
			1
			13
			-

No difficulty will be encountered n finding a large tumour but many lesions a e only 1 cm. to 2 cm. in diameter and son e even smaller. If the tumour is on tle anterior surface of the gland it will be ıd

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T/ BLE VI.—Complications Encountered with ISLET-CELL TUMOURS

		1	V	0.	. 6	oj	1	p	a	tie	ents
Ps udocyst following operation	,								,		3
Recurrent adenoma								,	,		1
Pe manent cerebral damage											1
To mours not clinically recognized.		 									2

recognized as a smooth homogeneous nedule, the colour of which is usually a li le darker than that of the surrounding n rmal pancreas. Unfortunately many of the small tumours are situated within the substance of the pancreas and cannot be seen on initial inspection.

If after a very thorough and painstaking search a tumour is not found in the pancreas one must look for ectopic pancreatic ti sue. If the search proves negative, resection of the body and tail is justified b cause there is the greatest likelihood of finding a tumour. If a single nodule is found in the head of the pancreas, simple enucleation is the safest procedure. If however, multiple tumours are present or enucleation is impossible pancreaticoduodenectomy may be necessary.

Three patients developed a pseudocyst following operation. Two of these required surgical drainage and one cleared up spontaneously. In both patients operated upon, fistulas persisted for several weeks but healed eventually. One developed a rather serious hæmorrhage after an attempt was made to obliterate the fistula by the use of silver nitrate.

In several instances drainage of pancreatic fluid after removal of the drainage tube from the operative site, persisted for periods of several days to a few weeks.

All wounds eventually healed spontaneously without further complications.

TABLE VII.—REQUISITES FOR DIAGNOSIS OF ISLET-CELL TUMOURS

- 1. Attacks of insulin shock occurring during fasting or fatigue states.
- 2. Blood sugar levels below 50 mg. % (in some cases below 30 mg.%) during an attack.

  3. Prompt relief on giving glucose.
- 4. Ruling out self administration of insulin.
- Exclusion of other causes of hypoglycæmiafunctional etc.

There were two postoperative deaths. The first patient was a 69 year old woman who had a splenectomy and resection of the tail of the pancreas for an adenoma which histologically proved to be malignant. She lived 29 hours after the intervention in a state of collapse with hyperpyrexia and cyanosis. The second patient was a woman 46 years of age who underwent subtotal pancreatectomy; subsequent examination revealed an adenoma in the tail. She died 48 hours postoperatively with a temperature of 107° F. Permission for post-mortem examination was not obtained.

One patient developed symptoms of severe hyperinsulinism seven years after removal of an adenoma. At the second operation nine years ago another discrete adenoma was removed; the patient has been symptom free ever since. Another patient has been left with pronounced cerebral damage after having been admitted to hospital in an unconscious state. She had suffered attacks of loss of consciousness and generalized convulsive seizures for four years, and although she has shown some improvement since removal of an adenoma, the prolonged periods of hypoglycæmia which she sustained before operation have permanently injured her central nervous system.

There were two patients in whom a clinical diagnosis of encephalitis was made but at post-mortem an adenoma was found. In one patient the diagnosis of hyperinsulinism was considered.

#### DIAGNOSIS

The diagnosis of functioning islet-cell tumours of the pancreas is essentially that of hyperinsulinism and this must be considered in dealing with obscure cases of coma, confusion or convulsions. In several of our patients the diagnosis was suspected in the psychiatric or neurological wards where they had been under investigation for convulsions and other neurological disorders. The history of the attacks is the most important factor in arriving at the diagnosis, and has to be explored in great detail. The circumstances of the first attacks and their relationship to fasting, whether constant or inconstant, to exertion or to emotion, the presence of early morning episodes and their relief with the administration of carbohydrates, are essential features of the history.

The non functioning islet-cell tumour is not usually suspected before operation. In some cases there is an abdominal mass in the right upper quadrant but physical examination usually shows no abnormalities. These patients are often obese because of increased intake of carbohydrates. Intolerance to fasting is the most satisfactory diagnostic procedure we possess. The patient is admitted to hospital and observed during a period of deprivation of food up to 72 hours. He is allowed water and tea without sugar or cream; at the first sign of an attack a blood sugar determination is done and the patient remains under constant observation until the physician decides to terminate the test. The patient may be subjected to strenuous exercise in an attempt to precipitate an attack. Multiple blood sugar estimations are often required. A value of 40 mg. % in the presence of hypoglycæmic symptoms relieved by oral or intravenous administrations of glucose is diagnostic.

Functional hypoglycæmia may mimic the symptoms of hyperinsulinism. This entity tends to occur in emotionally unstable individuals who are prone to weak or fainting spells with rapid spontaneous recovery. Their blood sugar level rarely goes below 60 mg. %. They seldom have convulsive seizures and their attacks, unlike those of the patients with an organic lesion, do not commonly occur at night. The symptoms usually come on following the taking of food rather than after fasting.

The so called alimentary hypoglycæmia is seen in patients who have undergone gastric resection or gastroenterostomy. It occurs usually soon after the taking of food and is rarely associated with very low blood sugar levels. Hypoglycæmia may also be associated with liver disease but there are usually other findings which suggest hepatic involvement.

Organic hypoglycæmia with relative hyperinsulinism occurs in a small percentage of patients with panhypopituitarism and adrenal insufficiency. In two patients not included in this series, the diagnosis of hyperinsulinism was considered but after careful investigation it was found that both of them had been giving themselves insulin.

#### SUMMARY

Twenty-two cases of islet-cell tumours of the pancreas are reported. Of these 17 were benign and five malignant; 16 of the benign lesions are considered to be functioning tumours producing hyperinsulinism, while two of the malignant tumours had metastases and three did not. One of the malignant tumours was considered to be functioning and causing hypoglycæmia. One patient developed recurrence of hypoglycæmic symptoms and at a second operation performed seven years later, another adenoma was found.

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#### RÉSUMÉ

Les tumeurs des ilôts pancréatiques sont rares, mais il faut évidemment y penser dans le diagnostic différentiel des hypoglycémies. Lorsque le diagnostic exact a été posé, l'ablation de la tumeur donne dans ces cas des résultats spectaculaires.

Le présent article passe en revue 22 cas de ce genre, relevés dans les archives de l'Hôpital général de Toronto et de l'Hôpital Sunnybrook, entre 1929 et 1959. L'âge moyen où l'affection se recontre à son maximum est 30-40 ans. Le diagnostic n'est pas aisé et parfois il n'a pu être fait qu'à l'autopsie. D'une façon général, les symptômes "neurologiques" sont les plus communs: évanouissement, perte de connaissance, faiblesse, changement de la personnalité, perte de mémoire et somnolence. Deux patients furent même admis dans le coma. Dans 15 des cas tous ces troubles étaient elle-même n'est pas facile à détecter et il peut même arriver que l'on ait du mal à la localis relors de l'intervention: il faut alors ne pas néglig et de chercher des ilôts pancréatiques aberrants. Si rien de pathologique n'est découvert, la résection pancréatique est indiquée, car les lésions ne so it fréquemment que microscopiques.

Sur les 22 cas rapportées ici, 17 ont trait à des tumeurs bénignes dont 16 fonctionnelles hyperinsulinisantes; les cinq autres étaient milignes, dont une fonctionnelle. Le traitement coisiste en l'énucléation si la tumeur est bien limité; les autres types, où les tumeurs sont multiples nécéssitent la résection pancréatique.

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## ADRENAL CARCINOMA®

J. E. LEDDY, F.R.C.S.[C], F.R.C.S.(Edin.), F.A.C.S.,†
L. M. BRAND, B.A., M.D. and K. J. POSTMA, M.D., Saskatoon, Sask.

## Introduction

THE ADRENAL GLAND although weighing only about 8 g. is nevertheless a very important organ. Thirty or more steroid compounds have been isolated from its cortical extracts, which may be grouped as follows:

- 1. Those affecting electrolytes-(D.O.C.A.
- and aldosterone).

  2. Those affecting carbohydrate metabolism (11-hydroxycorticosterones).
  - 3. The androgens.

# Classification of Adrenal Tumours (Cahill¹)

- Stromal: fibroma, lipoma—these are of no importance.
- 2. Medullary cell tumours, derived from the ectodermal sympathetic system.
- (a) Neuroblastoma, derived from embryonic sympathetic nerve cells.
- (b) Ganglioneuroma, derived from the sympathetic ganglion cells.
- (c) Pheochromocytoma, derived from the hormonal cells (pheochromocyte).
- 3. Cortical tumours, derived from the mesodermal glandular cells of the cortex.
  - (a) Benign adenomas
  - (b) Carcinomas

Clinical Syndromes associated with malfunction of adrenal cortex, in post-pubertal cases.

- 1. Adrenogenital Syndrome, caused by adrenal hyperplasia, adenoma or carcinoma,
- (a) Masculinizing, *true virilism* in women with hirsutism, acne, amenorrhœa, clitoral enlargement and voice changes.
  - (b) Feminizing, very rare.
- Adrenocorticoid (Cushing's disease)
   "Buffalo" obesity, plethora, abdominal striæ, hypertension, diabetes, amenorrhæa,

osteoporosis, etc. Classical Cushing's syndrome is considered due to a basophil adenoma of the pituitary. Cushing's disease may be due to adrenal hyperplasia, adenoma or carcinoma; although there are certain adrenogenital features, there is no true virilism.

3. Conn's syndrome (Primary aldosteronism)

Polyuria, polydipsia, hypertension, intermittent paralysis and tetany. Serum sodium is elevated, serum potassium is low, metabolic alkalosis present and renal concentration poor. This syndrome may be present in adenoma or carcinoma of the adrenal cortex but is not found in adrenal hyperplasia.

4. Mixed Tupes

Combinations of the above three syndromes.

#### Literature

Adrenal carcinoma may be primary or secondary. About 75% are primary. They may be non hormonal or hormonal in type.

- (a) Non hormonal adrenal carcinomas usually occur between 40 and 60 years of age. They are slow growing, become large, cause pain in the flank, etc. They are not as a rule diagnosed before they metastasize to the lungs. Rapaport says 94% of non hormonal tumours of the adrenal are malignant.
- (b) Hormonal adrenal carcinomas. Campbell<sup>2</sup> says about 60% of hormonal adrenal tumours are malignant.

Most articles in the literature are in the form of single case reports. Wood et al.<sup>3</sup> in 1957 found only 27 well authenticated cases of the non hormonal type of carcinoma of the adrenal cortex in European and American literature since 1923. They reported a further eight cases.

There are a few references to hormonal carcinomas of the adrenal. Rapaport et al.<sup>4</sup> in 1952 reported only 72 masculinizing tumours of the adrenal cortex in a recent 20 year survey, extending from 1930-1949.

<sup>&</sup>lt;sup>o</sup>Presented at the Annual Meeting, the Western Division of the Canadian Clinical Society of Surgeons, February 1958.

Surgeons, February 1958.
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In 1955, Foye and Feichtmeir<sup>5</sup> reported the case of a 60 year old man who presented with mineralocorticoid effects only, there being no virilizing effects. Apparently this abnormality was due to excessive aldosterone secretion. Hypokalæmia was marked. The patient survived eight months after surgical removal of the tumour. Reviewing the literature in 1956, Guin and Gilbert<sup>6</sup> found only 29 cases of Cushing's syndrome in children caused by adrenal carcinomas.

Hamm and Weinberg<sup>7</sup> of New York reported in 1955 that between 1950 and 1953 they handled 20 adrenal cortical tumours of which 11 were carcinomas. In only four of the carcinoma cases was a diagnosis made before development of metastases. These four patients were operated upon. Three died in one year and one is a five year cure.

It was decided to collect the figures of the Saskatchewan Cancer Commission from the Saskatoon and Regina Clinics. Since the clinics began 25 years ago there have been 17 cases of adrenal carcinoma out of 26,000 cases of malignancy of all types. The general characteristics are as follows:

Age: Two were in children age five and eight years; one in a man of 24 years, and the others in adults of ages ranging from 44 to 75 years. It therefore tends to be a disease of later life; in fact 12 of the 17 patients were over 50 years of age. The hormonal type is usually found in younger patients, yet a woman of 70 presented with a syndrome of Cushing.

Sex: Nine were women and eight were

Types: Twelve were non hormonal and five were hormonal.

Of the five hormonal cases:

Two manifested the adrenogenital syndrome.

Two manifested the adrenocorticoid (Cushing) syndrome.

One (our case) is a mixed type, showing true virilism and hyperaldosteronism.

Clinical features: The non hormonal cases were for the most part rapidly fatal. Survival times averaged from about six to eight months from onset of symptoms to death. Most of them presented with an abdominal mass associated with pain in the upper

abdomen and flank. Most of them hal secondaries in the lungs, brain etc., who a first seen. Two of these tumours were removed as suspected kidney tumours, the others were diagnosed at autopsy. The homonal cases—the two children—showed precocious sexual development, pubic has, enlarged clitoris, etc. The two cases for Cushing's syndrome (ages 47 and 70) we extypical.

Results: Surgical removal was done two out of the 12 non hormonal cases at 1 in all five of the hormonal cases. All 2 patients with lesions of a non hormonal nature are dead, most having died with a six months of onset of disease. Two of the five patients with hormonal lesions are living. One, aged 47 years, is alive six years after removal of the tumour but pulmonary metastases have been present for the past three years. One patient is alive two and one-half years after the first operation but a second operation has been performed for local recurrence. The other three lived eight days, one month, and six months respectively after surgical removal. The results in this series of treated and untreated patients is uniformly poor. Our case is presented as an example of unusual hormonal changes. It was diagnosed preoperatively. Patients have no chance of relative cure unless diagnosed very early. Early diagnosis would appear to be more likely in hormonal rather than non hormonal cases.

### CASE REPORT

#### History

A 22 year old, single woman school teacher came to our office on November 6, 1957, with a main complaint of headaches, localized in the frontal and occipital regions, and appearing chiefly at night. These headaches which began in the spring of 1956, were considerably relieved by walking around but not by ordi ary medication such as aspirin etc. Occasio :ally they were accompanied by nausea bit seldom by emesis. Her menstrual periods had occurred regularly until November 1956 b t there had been an absolute amenorrhœa sinc: Four months before this first visit she noticed an increase in hair growth on her face, lim s and abdomen. At this time she gradually lot her singing voice and became more and mo e disinterested in the opposite sex. Coincide t

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with these changes was a decrease in breast size, a gradual onset of fatigue and weakness and a progressive loss of appetite. An unusual complaint was an increased tendency to bleed from cuts and bruises. In the evenings she had been and significantly swollen but at not time did her hands swell or was her face puffy.

Finally she found it impossible to continue taching school and decided to seek medical alvice.

Her menarche had taken place at age 11, and no irregularities were noted until the amenorrhoea starting in November 1956. She had always felt well until the onset of the present complaints and the only history of a single procedure was tonsillectomy and adenoidectomy performed when she was seven years old. There was no family history of endocrine abnormality and indeed her parents and only brother were alive and well.

# Physical Examination

Physical examination revealed an alert, well nourished girl of stated age, in no acute distress. She had definite masculine features characterized by coarse skin with scattered evidence of acne and an abundance of facial hair. The head and neck were otherwise not remarkable. Fundi were within normal limits. Chest was clear. The heart was clinically not enlarged and no murmurs could be elicited. Her blood pressure was found to be elevated to 210/130 mm. of mercury and the pulse was 76, regular, equal and synchronous. The abdomen was soft to palpation and no masses could be felt, although one of us thought he could feel a vague fullness in the left flank. A definite masculine distribution of pubic hair was present. Because of an intact hymen, with an orifice admitting only the tip of the examining finger, pelvic examination was not performed in the office. However, it was noted that the clitoris was grossly enlarged. Rectal examination was normal. Urological examination was within normal limits. The patient was admitted to St. Paul's Hospital, Saskatoon, on November 20, 1957.

# Methods of Investigation Employed

- Complete routine examination of blood and urine.
- 2. Determination of serum electrolyte levels and establishment of a glucose tolerance curve.
- Intravenous pyelogram and radiographs of kidney, ureters and bladder.
  - 4. Radiological investigation of chest and

- skull with emphasis on appearance of sella turcica.
- Pelvic examination under anæsthesia.
- Estimation of hormone levels in the urine;
   17-ketosteroids and aldosterone; cortisone suppression and Allen tests.
- 7. Presacral (CO<sub>2</sub>) insufflation with planigrams.
  - 8. Electrocardiogram.

# Laboratory Results

Hæmoglobin 13.02 g. %; white blood cells 8800 per c.mm. with normal differential count; erythrocyte sedimentation rate 19 mm./hour (Westergren). Urinalysis was negative for albumin and sugar; specific gravity 1.018; microscopic examination was negative. Other values included: nonprotein nitrogen level 17.5 mg. %; fasting blood sugar 84 mg. %; glucose tolerance curve, normal; serum chlorides 632 mg. % as NaCl (108 mEq./l.); serum sodium 148 mEq./l.; bleeding and clotting times were normal. Capillary fragility was normal but the patient had a positive Trousseau's sign which was noted while the test for capillary fragility was in progress. Clot retraction was normal and the Mantoux test was negative. The 17-ketosteroids were estimated at 31.7 mg, per 24 hour urine specimen. We were unable to obtain aldosterone levels since the facilities for such an assay were not available to us.

### Radiological Findings

Chest radiograph revealed clear lung fields. The heart was normal in size and configuration. Films of the skull showed a normal sella turcica. A scout film of the abdomen was normal and an I.V.P. showed good and prompt excretion of the dye from both kidneys. No masses could be identified.

#### Further Investigation

During a pelvic examination performed under anæsthesia, the uterus was noted to be normal in size, both ovaries were palpated and found to be of normal size, and no masses could be felt. Once again the considerably enlarged clitoris with a pseudo-prepuce was noted.

At this time we felt that on the evidence available a diagnosis of Cushing's disease or Stein-Leventhal syndrome could be ruled out. We thought that the pathological lesion in this patient was connected with one or both adrenal glands. To rule out adrenal hyperplasia, a cortisone suppression test was performed with

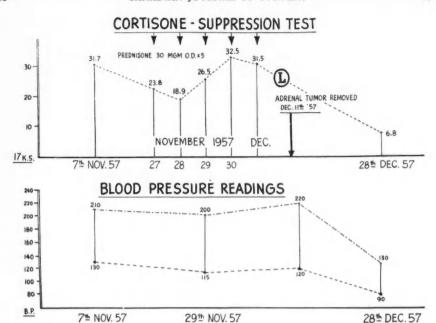


Fig. 1.—Variations in 17-ketosteroid and blood pressure levels during the cortisone suppression test.

the daily administration of 30 mg, of prednisone for five days. Twenty-four hour urine specimens were collected for five consecutive days. Results are shown in Fig. 1. Fractionation into alpha and beta portions done on specimen 2 was as follows:

Alpha fraction 17.4 mg. per 24 hour specimen.

Beta fraction 1.5 mg. per 24 hour specimen.

The Allen test for dehydroepiandrosterone was negative. Because there was no appreciable fall in 17-ketosteroids during the suppression test and because the Allen test was negative, it appeared that we were dealing with an adrenal tumour that probably was benign. A presacral retroperitoneal insufflation of CO, (Fig. 2) was done on December 7, 1957, and showed a rounded density measuring 6.5 x 4 cm. above the upper pole of the left kidney. The right adrenal gland appeared normal. It is also interesting to note that at this time a 12 lead E.C.G. showed definite abnormalities, in that the ST segment was sagging in leads II, III, AVF, V1, V2, V3. The T wave was of low voltage and diphasic in II, AVF, V1, V2, and V3 and inverted in III. The internist interpreted this as being consistent with coronary artery disease.

A preoperative diagnosis of left adrenal adenoma was made and the patient prepared for operation.

Preoperative care. — Most patients with adrenal carcinoma that come to operation may suffer from acute adrenal insufficiency because



Fig. 2.—Presacral retroperitoneal insufflation of carbon dioxide outlining a rounded density above the upper pole of the left kidney.

he contralateral adrenal is usually depressed owing to excess corticoid secretion from the arcinoma. This is true in Cushing's syndrome. We felt that our case was a mixed type and hat she therefore, should be protected from possible Addisonian crisis following removal of he tumour. Thus the following program was dopted.

ORTISONE GIVEN BEFORE, DURING AND AFTER UNILATERAL ADRENALECTOMY:

Preoperatively (one and one-half days) Cortisone 50 mg. i.m.-q.6.h. x 6 doses

During operation

Hydrocortisone sodium succinate (Solu-cortef) 50 mg. i.v.

ostoperatively

Cortisone 50 mg, i.m.-q.6.h. x 8 doses Cortisone 50 mg, i.m.-q.8.h. x 9 doses Cortisone 50 mg, i.m.-q.12.h. x 2 doses Cortisone 50 mg, i.m. daily x 3 doses Cortisone 25 mg, i.m. daily x 3 doses

## Operation

On December 11, the patient being anæsthetized with sodium thiopental plus 0.1% succinylcholine chloride and nitrous oxide and oxygen by endotracheal intubation, a curving incision was made about half an inch above the umbilicus, extending upwards, laterally and posteriorly along the line of the ninth left intercostal space. The peritoneal cavity was opened and the right adrenal gland on palpation appeared normal in size. Both ovaries were normal. No lesion was noted within the abdominal cavity.

The incision was then extended upwards through the subcostal margin along the ninth intercostal space. The diaphragm was then split from in front posteriorly for about six inches. Immediately posterior to the spleen the left kidney could be felt; but quite separate and movable above the kidney was a tumour which was about 3 in. x 2 in. The peritoneum over the tumour was incised and the tumour was mobilized down to its pedicle. Vessels entered the gland from three directions; they were separately divided and tied. The tumour was easily removed. An intercostal drain was brought out through the eighth space in the mid axillary line.

### Pathology

Gross description.—The 58 g. roughly spherical capsulated tumour was approximately 4 cm. in diameter (Figs. 3, 4, 5 and 6). Its cut surface was variegated pale brown



Fig. 3.—Tumour weighed 65 g. and was apparently encapsulated but close inspection reveals small capsular defects.

and yellow, and divided into lobules ranging in size from 2.5 cm. downwards. The blood supply was contained in a leash of tiny vessels which spread across the surface of the tumour before penetrating its capsule.

Microscopic description. — On section the tumour was seen to be composed of cords and clusters of cells in a scanty stroma with many sinusoidal vessels. There were several areas of hæmorrhagic necrosis. The tumour was surrounded by a thin collagenous capsule infiltrated by tumour cells in several places. The infiltrating cells mostly lay in small cords compressed by the capsular tissue but in a few places they appeared to lie in lymph spaces. Sections of the vascular pedicle showed that the accompanying fibro-fatty tissue was



Fig. 4.—Cut surface lobulated. Dark red hæmorrhagic areas, orange areas of degeneration. Tumour tissue is brown.

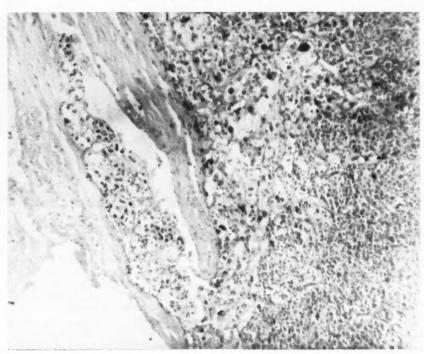


Fig. 5.—The tumour has broken through the capsule. This is the hallmark of malignancy (X 740).

infiltrated by the tumour. Individually, the cells showed considerable morphological variations. While most had fairly well defined pale granular cytoplasm and a round vesicular nucleus, giant forms, some of which contained several nuclei or large irregular nuclei were common. Elsewhere the cytoplasm was dark and less plentiful and the nuclei were somewhat pyknotic. Mitoses were fairly frequent. Many groups of cells contained sudanophilic granules. Sections of chromated material failed to demonstrate any brown pigment. The histological diagnosis was adenocarcinoma of adrenal cortex.

## Postoperative Course

The immediate postoperative course was uneventful. Blood pressure remained constant at 160/110. On the third postoperative day the serum sodium was normal but the serum potassium was low at 2.8 mEq./l. The patient was given potassium chloride 10 grains (0.6 g.) q.i.d. and the potassium level rose subsequently to 4.6 mEq./l. Three weeks after operation blood pressure was 130/90 and 17-ketosteroids were 6.8 mg. per 24 hour urine specimen. During the following months her

breasts increased in size and there was less hair growth on the face and limbs. A normal menstrual period occurred from January 20 to January 24. In the subsequent months she remained free from headaches, her appearance was definitely more feminine, she was able to sing high notes once again and had regained a normal interest in the opposite sex. An electrocardiogram taken on January 18, 1958, was normal. She was followed by the Saskatoon Cancer Clinic, her last visit being in August 1958, at which time a chest radiograph showed no intrapulmonary or bony metastases. She was otherwise in fairly good health. Subsequently the patient moved to British Columbia to resume school teaching.

This paper was ready for publication when we received a communication from Drs. B. K. MacKay and O. A. Weir<sup>8</sup> of the Irving Clinic in Kamloops, B.C. A brief summary of their findings may be of interest.

On February 3, 1959 this patient reported to the Clinic with a recurrence of frequent headaches associated with depressed states

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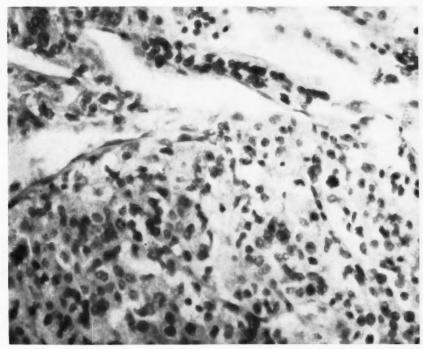


Fig. 6.—Microscopic structure of areas free of degeneration, Trabecula of cells with voluminous, thin cytoplasm, variable nuclei, some mitotic figures. Many vascular sinuses (X 740).

which tended to alternate with excessively high spirits. Once again she was tiring easily and had frequency particularly at night. Her periods were regular but becoming increasingly heavy. On two examinations blood pressure was noted to be 170/120. She was admitted to hospital in Kamloops on February 6 for a biochemical, radiological and clinical evaluation of her condition. Physical examination was negative except for the blood pressure 170/120, some masculine distribution of hair on the abdomen and persisting clitoral enlargement. A provisional diagnosis of metastatic adrenal adenocarcinoma was made at the time. The level of 17-ketosteroids was then 14.6 mg./24 hours, and it was not felt that there was sufficient evidence to subject her to any radical procedure.

On October 21, 1959, she was readmitted with a blood pressure of 250/140. Her hirsutism had increased markedly, her voice had deepened, amenorrhœa, physical weakness and mental depression had recurred. At this time the 17-ketosteroids were returned at a level of 143 mg./24 hour and the 17-hydroxycorticosteroids at 46 mg./24 hour specimen. Serum

chlorides were elevated to 118 mEq./l. and  $CO_2$  combining power was 35 mEq./l. Serum sodium and potassium levels were normal. She was readmitted to the Royal Inlands Hospital, Kamloops, on November 28, 1959 for adrenal-ectomy.

Operation was carried out through a midline upper abdominal incision for the purpose of exploring the entire abdomen. Everything in the abdomen appeared normal except for a recurrent tumour in the left adrenal region. A mass, 12 cm. in height and 4 to 6 cm. in width was removed. At the beginning of the operation the patient's blood pressure had been 180-190/110-130; at the end of the procedure it was 135/90.

We saw her again on December 19, 1959. At this time she stated she was feeling very well, was having no headaches, her strength was returning and she did not tire so easily. Her skin looked quite feminine with none of the coarseness with which it first presented. She was referred again to the Saskatoon Cancer Clinic for cobalt 60 therapy to the left adrenal region, which is being carried out at the time of writing.

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#### COMMENT

Adrenocortical carcinoma is generally considered to be a highly malignant and rapidly invasive tumour. The only treatment is surgical removal before it metastasizes. Local recurrence is common. Cases are recorded with three and four operations. Early diagnosis is not possible unless hormonal changes are present. This case is interesting because of the unusual finding of true virilism associated with hyperaldosteronism.

## SUMMARY

The clinical syndromes associated with malfunction of the adrenal cortex in postpubertal cases are listed.

Brief reference is made of literature pertaining to adrenal carcinoma.

A series of 17 cases of adrenal carcinoma seen at the Saskatoon and Regina Cancer Clinics between 1934 and 1959 is reviewed.

A method of diagnosis of adrenal carcinoma is noted.

A case of a woman, aged 22 years, with an adrenal carcinoma presenting as a "mixed" type of syndrome is described.

## ACKNOWLEDGMENTS

The authors wish to thank Dr. F. Young, Chief of the Department of Pathology, St. Paul's Hospital, Saskatoon, for photomicrographs and other assistance; Dr. D. C. Wolan for presacral CO<sub>2</sub> insufflation, and Dr. T. A. Watson, Director of the Saskatchewan Cancer Clinic for permission to use clinic statistics.

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## RÉSUMÉ

Cet article rapporte l'histoire du cas d'une jeune fille de 22 ans, maîtresse d'école, qui fut vue en consultation pour la première fois pour des maux de tête localisés dans les régions frontales et occipitales, survenant principalement la nuit. Des nausées apparaissaient aussi de temps à autre, ainsi que des vomissements; depuis quelques mois, la malade avait remarqué une augmentation de la pilosité de sa figure, de ses membres et de son ventre. Peu après, sa voix changea, sa libido régressa, ses seins diminuèrent de volume, une fatigue générale apparut. A l'examen physique, on ne notait rien de particulier, si ce n'est une pilosité de type masculin, et, du point de vue génital, une hypertrophie clitoridienne. Les épreuves radiologiques (poumons, film à vide de l'abdomen, pyélographie endoveineuse) étaient normales. De même, la radiographie du crâne ne montra aucune anomalie de la selle turcique. Ceci, avec divers examens de laboratoire, fit penser à une hypertrophie surrénalienne; un test de suppression à la cortisone fut effectué, qui ne montra aucune chute des 17-cétostéroïdes; un test d'Allen pour la déhydroépiandrostérone fut négatif. On pratiqua alors une radiographie après insufflation rétropéritonéale, qui mit en évidence une opacité arrondie de 6.5 x 4 cm. au pôle supérieur du rein gauche.

Le diagnostic d'adénome surrénal gauche fut donc posé. Après un traitement préparatoire hormonal (destiné à pallier l'insuffisance sécrétoire contra-latérale), la malade fut opérée: on trouva une tumeur surrénalienne qui fut enlevée. Il s'agissait, du point de vue anatomo-pathologique, d'un adénocarcinome du cortex surrénal. En ce qui concerne les suites post-opératoires, la patiente ne présenta dans l'immédiat rien. de spécial; elle fut par la suite grandement améliorée; malheureusement deux ans plus tard une récidiue se fit.

ment, deux ans plus tard, une récidive se ît.

A cette histoire de cas, les auteurs joignent une
mise au point de la question: classification des
tumeurs surrénaliennes, syndromes cliniques, reque
de la littérature, traitement.

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# THE FLEXURE SYNDROME: RELATIONSHIP OF BOWEL ANGULATION TO OBSTRUCTION\*

W. R. GHENT, M.D., C.M., F.R.C.S.[C],† Kingston, Ont.

THE PURPOSE of this paper is to present two cases of perforated cæcum and to offer a mechanical cause for the so-called "spontaneous" perforations of the cæcum. A name for this syndrome is suggested.

The first case is that of a 78 year old white woman who fell down the cellar steps on July 23, 1956. Following this she noticed it creasing pain in her left chest and hæmopysis. She was admitted to the Hôtel-Dieu Hospital, Kingston, on July 24, 1956. Radiogaphs of her chest showed fractures of the left sixth, seventh and eighth ribs in the midatillary line and of her 11th rib posteriorly. It was noted that her stomach was grossly distended with gas.

On July 25 and 26 abdominal distension increased, bowel movements and flatus were absent, and vomiting had occurred. On July 27 a Levine tube was inserted and continuous suction was maintained until the evening of July 30, 1956. Vomiting recurred at about 9 p.m. on July 30, and the tube was reinserted. Severe right lower quadrant pain started at 1 a.m. the following morning, July 31, eight days after injury.

We first saw the patient at 4 a.m. on July 31, and at this stage she presented a grossly distended, rigid abdomen, with signs of free air in the peritoneal cavity. The point of maximum tenderness was over the right lower quadrant. Rectal examination revealed a ballooned rectum with tenderness high on the right side. The differential diagnosis entertained included a perforated duodenal ulcer, perforation of the execum due to distal obstruction, or perforation of the small bowel due to trauma.

At laparotomy, a large perforation on the anterolateral surface of the cæcum was found and, in addition it was noted that the ascending colon and the cæcum were grossly distended. The bowel distal to the hepatic flexure was collapsed. The perforation was repaired, the right phrenicocolic ligament was divided and a cutaneous cæcostomy was fashioned.

Postoperatively the patient developed a deep

thrombophlebitis in her left leg. Heparin therapy was instituted, and following this, she had a massive gastrointestinal hæmorrhage. This was controlled by transfusion and cessation of anticoagulants. Bowel function was restored ten days following her laparotomy and the cæcostomy was closed surgically five weeks after the original operation. Her progress since then has been unremarkable.

The second case is that of an obese 67 year old white man. On April 12, 1959, this man suffered an attack of syncope after a severe coughing spell. In falling, he injured his back. He was admitted to the Hôtel-Dieu Hospital on April 17 complaining of severe pain in his lower back, and constipation. Radiographs taken on admission showed evidence of a comminuted fracture of the body of L1. During the next three days he continued to complain of constipation and back pain. The constipation was only partially relieved by enemas. It was noted that his abdomen remained distended.

On the evening of April 20, 1959, the patient was nauseated and at about 2 a.m. on April 21 he experienced sudden severe right lower quadrant pain. This continued until we saw the patient at 8 a.m. on April 21, nine days following injury. At this time the patient's abdomen was huge, partly due to distension and partly due to obesity. Bowel sounds were absent and marked rigidity was present in the right lower quadrant. Rebound tenderness was referred to this area. Signs of free air were present. Radiographs of the abdomen confirmed the presence of a large amount of free gas and revealed a grossly distended transverse colon (Figs. 1 and 2).

A diagnosis of a splenic flexure syndrome with perforation of the cæcum was made and this was confirmed at laparotomy, when a large perforation in the anteromedial wall of the cæcum was found. The cæcum was collapsed but showed evidence of its previous gross dilatation. The transverse colon still presented gross dilatation and this ceased abruptly at the splenic flexure. The descending colon was contracted. The peritoneal cavity contained about two quarts of liquid fæces which were removed with suction. The perforation was repaired and a catheter type cæcostomy fashioned. This method was chosen

<sup>&</sup>lt;sup>o</sup>Presented at the Canadian Association of Clinical Surgeons, November 7, 1959.

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Fig. 1.—Radiograph of Case 2 showing gross distension of transverse colon.

because the thickness of the abdominal wall precluded a cutaneous execostomy. The obesity and distension also prevented incision of the left phrenicocolic ligament. Postoperatively this patient did not do s well as expected. He required digitalization for an irregular cardiac rhythm and he suffered an evisceration on his fourth postoperative day. This complication was repaired without incident. However, his course was stead y downwards and he died on May 2. During this time, in spite of all efforts, we did not consider that his execostomy functioned adequately.

At post-mortem, severe dilatation of the terminal small bowel, ascending colon, and transverse colon was noted and the cause of death was thought to be due to persiste the paralytic ileus.

## DISCUSSION

Perforations of the cæcum secondary to obstructions and trauma have been recognized since 1880 when first reported by Heschl.¹ Since that time this complication has been well documented and a mortality rate established that varies between 35%,² and 72%.³ Periodically reports have appeared suggesting that spontaneous perforation of the cæcum can occur in paralytic ileus.⁴ 8 It is this latter group of cases that interests us and on review of the published

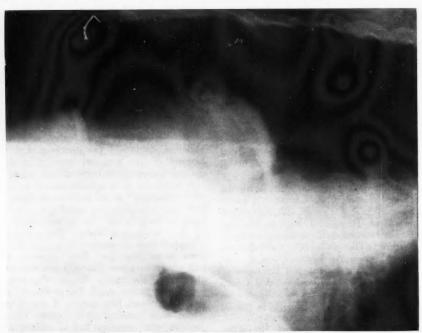


Fig. 2.-Radiograph of Case 2 in lateral decubitus showing a large amount of free air.

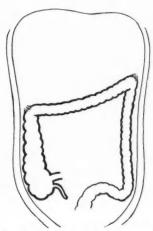


Fig. 3.—Possible peritoneal fixations of the colon at he hepatic and splenic flexures.

reports, we find that these spontaneous perforations of the cæcum are, indeed, cases of this new syndrome, 'The Flexure Syndrome'.

To reconstruct the train of events in cases of this syndrome, the two cases cited previously can be regarded as classical. Paralytic ileus is induced by injury such as fractured ribs or fractured spine, or by disease such as herpes zoster. During the paralytic stage, gas accumulates throughout the gastrointestinal tract. There is a functional gradient from above downwards in the gastrointestinal tract. Thus, in recovery from a paralytic ileus, the stomach begins to function first and so on down the small bowel until finally, the colon regains its lost contractility.

However, as contraction returns large amounts of gas, swallowed air, and fluid are forced through the small bowel and emptied into the low pressure cæcal reservoir. If the cæcum and ascending colon have not regained their contractility, they will distend and as they become distended, all hope of normal contractility is lost. The stage is now set for the development of the syndrome and this can occur at the hepatic or splenic flexure.

The colon can be fixed to the posterior abdominal wall at the hepatic flexure and at the splenic flexure by the right and left phrenicocolic ligaments (Fig. 3). The accompanying diagrams show the sequence

of events at the hepatic flexure. As the cæcum and ascending colon distend the angle between the limbs of the colon is decreased. In addition, the ascending colon rotates clockwise and further decreases the angle. Once the critical angle has been reached, the initial benign paralytic ileus has become a mechanically complete large bowel obstruction (Figs. 4, 5, 6 and 7).

The amount of gas involved in this process may be great but the pressures are relatively low. The cæcal rupture pressure is in the range of 80 mm. Hg.2 The cæcum ruptures along its anterior surface and this mechanism is an actual perforation of the mucosa preceded by a diastasis of the muscle fibres.5 Rack6 has commented upon the fact that the cæcum usually remains distended in spite of perforation. This has not been confirmed by radiographs shown above. A competent ileo-cæcal valve is not a prerequisite for the development of this condition as is borne out by our second case. To recapitulate, the factors necessary for this syndrome are (1) the presence of a rather tight phrenicocolic ligament, (2) an untreated paralytic ileus.

## Diagnosis

The diagnosis of the condition is apparent if the condition is kept in mind. A patient with paralytic ileus who has begun to recover sufficiently to have bowel sounds is suddenly seized with severe pain in the right lower quadrant. Radiographs reveal gross distension of the excum and ascending colon, or the excum, ascending colon and transverse colon, with or without free gas.

#### Treatment

The treatment of the condition can be divided into three phases. These include (1) Prevention; (2) Treatment before rupture; (3) Treatment after rupture.

1. Prevention.—The reason that more of these cases do not occur is that active treatment of paralytic ileus is the rule rather than the exception. If, following paralytic ileus, the Levine tube is left in place until the patient is passing flatus and/or fæces, there will be no reason to fear this complication. If the Levine tube is removed

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as soon as bowel sounds are heard, the patient runs the risk of developing a flexure syndrome.

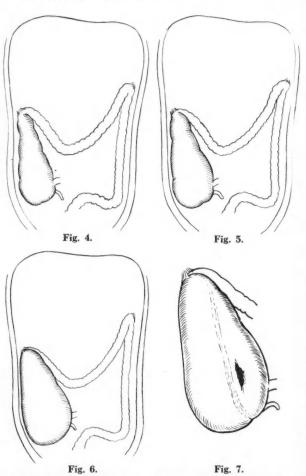
2. Treatment before rupture. — It has been shown by Wangensteen and by others that the cæcum is the weakest point in the gastrointestinal tract. The cæcum is not capable of hypertrophy in the face of chronic obstruction. The only accommodation is dialatation. The cæcal rupture pressure is about 80 mm. Hg as compared to the 230 mm. for the small bowel.

and Lowman7 Davis have been able to prove that the critical size of cæcal distension is 9 cm. as measured from the gaseous shadow on the radiograph. Any dilatation greater than this is fraught with danger. With these facts to hand, the presence of cæcal distension of 9 cm, or more suggests that laparotomy and cæcostomy should be carried straight away.

At laparotomy the offending phrenicocolic ligament is divided and the flexure freed. In addition, a cæcostomy must be established to provide continu-

ous deflation of the cæcum. It is imperative that the cæcostomy be fashioned to provide complete deflation and this can be accomplished by suturing the bowel wall to the skin after providing a liberal stoma. Failure to take this precaution resulted in tragedy in our second case. If the patient's condition is precarious, cæcostomy alone is the treatment of choice, fully realizing that the causative lesion is still intact. However, with the safety valve preventing colonic distension, the contractility of the large gut can be regained in safety.

3. Treatment after rupture.—The mortality rate of untreated cæcal perforations



Figs. 4, 5, 6 and 7.—Diagrams illustrating the flexure syndrome at the hepatic flexure. The progressive dilatation of the cæcum and ascending colon with perforation is shown.

approaches 100%; even with repair, the reported mortality rate varies from 35% to 72%. 2.3

The treatment of the flexure syndrome is the same whether or not the cæcum has become perforated. If there is a perforation it is closed and a cutaneous cæcostomy is fashioned. If the patient's condition permits, the offending flexure or peritoneal fold is incised and freed (Figs. 8 and 9). It is unwise to use the perforation as the cæcostomy.

The mechanics involved in the acute angulation obstruction of the small boyel have been recognized for some time. We



Fig. 8.—Incision of the phrenicocolic ligament and the closure of the perforation.

believe that the same mechanics can be applied to the large bowel when at any location an angulation is produced and maintained by a peritoneal fold. In the foregoing discussion, we have been primarily interested in the hepatic and splenic flexure. We are convinced that the same syndrome can involve the proximal or distal end of the sigmoid colon. A report entitled "Spontaneous perforation of the cacum without mechanical obstruction", seems to confirm this impression.

## SUMMARY

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We have presented two cases of cæcal perforation due to the flexure syndrome. The etiology, diagnosis, and treatment have been reviewed. We believe this to be a hitherto unrecognized nosological entity.



**Fig. 9.—Operative approach and repair of a** hepatic flexure syndrome.

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#### RÉSUMÉ

Périodiquement des rapports sont publiés au sujet de perforations spontanées du cæcum au cours d'un état d'iléus paralytique. L'auteur pense qu'il s'agit là d'un mécanisme pathologique particulier pour lequel il propose le nom de "flexure syndrome". Ce syndrome peut être expliqué de la facon suivante.

Une blessure quelconque (une fracture de côtes ou de la colonne vertébrale par exemple) en traîne comme complication un état d'iléus paralytique, au cours duquel des gaz sont accumulés dans le gros intestin et le tractus gastro-intestinal. Lorsque la paralysie cède, l'estomac reprend le premier ses mouvements péristaltiques, suivi de haut en bas par le grêle, puis par le côlon; par conséquent, les gaz et les liquides contenus dans l'estomac et le grêle vont être forcés dans le cæcum avant que les côlons aient repris leur activité normale, ce qui entraînera la dilatation de ces derniers. Du fait de la fixation du côlon ascendant à la paroi postérieure, cette dilatation aboutira à la diminution de l'angle hépatique ed l'angle splénique: à un certain degré, l'iléus paralytique sera transformé en une obstruction mécanique. C'est alors que le cæcum, qui ne peut supporter qu'une pression de 80 mm. de mercure est susceptible de se rupturer, le plus souvent sur sa face antérieure. En résumé, deux facteurs sont nécessaires pour l'installation de ce "flexure syndrome": (a) l'existence d'un ligament colicophrénique serré; et (b) un état d'iléus paralytique.

Le traitement de ce syndrome consistera en une cæcostomie, accompagnée d'une levée de l'obstacle (section du ligament phrénicocolique), si l'état général du patient le permet.

Deux cas de ce genre sont présentés et discutés.

# BENIGN GASTRIC TUMOURS OF NONEPITHELIAL ORIGIN REPORT OF THREE CASES

JEAN COUTURE, M.D., F.R.C.S.[C], F.A.C.S., Quebec

Although benign gastric tumours constitute only 2% of all gastric neoplasms, they have a definite clinical importance. Their interest is based upon the three following points:

1. The serious complications to which they give rise, especially gastrointestinal hæmorrhages.

The possibility of malignant degeneration.

3. Their prominence in the differential diagnosis of cancer.

In this paper, nonepithelial benign tumours originating from the gastric wall will be discussed, namely those arising from muscle, connective tissue, nerves, fatty tissue, blood vessels and lymphoid tissue. It is estimated that at least 60% of benign tumours of the stomach are nonepithelial. This figure is given by Minnes and Geschickter from a study of 931 cases.<sup>1</sup>

Classification of these neoplasms has been unsatisfactory and has consisted mostly of a listing of tumours without any attempt to group them under any definite heading. Such an enumeration is found in a review of the world literature by Palmer, quoted by Hudson and Richardson<sup>2</sup> in 1951, in which he reports 1605 benign gastric tumours. A more rational classification, proposed by France and Brines,3 is based on the cell type and tissue of origin with the assumption that all these tumours are of mesenchymal origin. However, schwannomas are derived from the ectoderm but have to be included here because of their frequency.

The clinical behaviour of these tumours depends very much upon their stage of development and their location in the stomach. At first, very vague digestive symptoms may be expected, associated with dyspepsia and epigastric pains. If the tumour is in the prepyloric region, signs of pyloric obstruction develop early in the disease. These tumours arise from any part of the stomach and tend to be spherical;

when they attain fairly large dimensions, ulceration of the mucosa by pressure necrosis gives rise to bleeding. Very serious hæmorrhage may result from a vasculur tumour. Not infrequently an unexplained anæmia may be the first manifestation.

In a large percentage of cases a mass with regular outline can be felt. It is often so with very large subserous lesions developing outside the gastric lumen. Such a possibility should be kept in mind even when the barium meal is reported as normal. Kert described an unusual case in which a large pedunculated mobile leiomyoma of the lesser curvature had occupied the left hypochondrium and caused a partial volvulus of stomach.

Diagnosis of a tumour of the gastric wall is usually made by radiological examination or gastroscopy. In most cases it is reasonable to assume that a tumour is benign, although malignancy cannot be excluded. The type of lesion, however, can only be determined by histological examination.

Because of lack of specific symptoms, diagnosis is often delayed until such complications as gastrointestinal hæmorrhages, or obstruction from a well-developed lesion draw the surgeon's attention. For the same reason, on account of their silent course, one benign gastric tumour may be encountered per one thousand autopsies. The three cases reported below illustrate the various clinical pictures presented by these tumours.

Case 1.—The patient was a 77 year old, obese man, admitted to our hospital in a state of shock after an acute episode of substern 1 pain, restlessness and dyspnœa. Symptom shad been present for only one hour before admission. A diagnosis of coronary thrombos swas made and the patient was placed in an oxygen tent and given cardiac stimulant. His past history was entirely free of any cardiac trouble or gastrointestinal disease. Hy died two hours after admission. At autops there was a recent myocardial infarct with extensive atherosclerotic deposits in the coror-

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a y vessels and the aorta. On the greater curvature of the stomach, near the cardia, a large tumour about 6 cm. in diameter, originating in the submucosa protruded in the lumen of the stomach. There was a small central a ea of ulceration but no signs of recent bleeding. The cut section revealed a hard whitish and homogeneous mass. Histological examination showed it to be a benign leiomyoma.

Case 2.-This 25 year old woman had repeated bouts of hæmatemesis and had passed tarry stools two months before admission to h spital. The last bleeding episode had been se severe that the patient had required several b ood transfusions. Five years before, a hypoe romic anæmia had been diagnosed and had failed to respond to medical treatment. A burium meal done in another hospital was reported as normal. Upon admission to our h spital, a search for a possible blood dyscasia seemed indicated in view of the fact that the patient had shown bleeding tendencies during her menstrual cycle, frequent nose bleeds and easy bruising. Laboratory tests were normal but the Rumpel-Leede (tourniquet) test was positive. The few digestive complaints elicited from that patient consisted mainly of heartburn and epigastric fullness. Examination of the abdomen showed some guarding in the upper epigastric region but no definite mass was palpated although the area appeared to be tender.

Another barium meal revealed the presence of a mass interposed between the fundus and the diaphragm. An ulcerated patch 2.5 cm. in diameter was seen in the central portion of the mass; the radiological appearance was that of "uterine cervix", characteristic of an ulcerated benign gastric tumour (Fig. 1).

At operation it was discovered that the tumour had caused an important reaction in the mesentery where several lymph nodes were felt. The mass was well encapsulated and measured 7 cm. in diameter; the mucosa was normal over the lesion except in the centre where a 2 cm. ulcer was present (Fig. 2). The cut section showed a homogeneous predominantly yellowish tumour. Microscopically it was a typical schwannoma (Fig. 3). A high (almost total) gastrectomy was performed and continuity re-established by gastroduodenostomy. Postoperative course was satisfactory and except for a mild dumping syndrome the patient is very well two years after.

Case 3.—A man of 45 years was admitted to hospital with a three month history of epigastric pain. He had no nausea or vomiting



Fig. 1.—Radiological study showing a very large tumour in the upper third of the stomach with an ulcerated patch giving the appearance of "uterine cervix".

and his symptoms seemed at their worst one hour after meals. Seven years earlier he had experienced a similar episode and, after radiological examination of his stomach, had been told that he suffered from duodenal ulcer. He was treated accordingly with a fair result although he had sustained occasional recurrences of his pains. Medication and diet were not very effective in relieving his distress. A repeat barium meal disclosed a very mobile and



Fig. 2.—Cut surface of the specimen resected in Case 2. Note central area of ulceration.

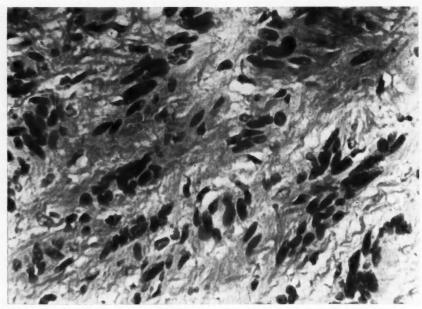


Fig. 3.-High power view showing the typical fusiform cells of a schwannoma.

smooth tumour of the prepyloric region on the lesser curvature (Fig. 4). It seemed to originate from the submucosa; peristaltic waves were not interrupted by its presence. Our radiologist made a diagnosis of leiomyoma or lipoma of the stomach. Gastroscopic examination showed a normal mucosa in the prepyloric region without any sign of tumour.

A gastrotomy was done in the prepyloric region and the tumour removed after incising the mucosa of the posterior wall of the stomach. It was a typical lipoma 3 cm. in its greatest diameter (Fig. 5). When seen six weeks later this patient was completely well and had had no recurrence of his pains.

## DISCUSSION

Those three cases demonstrate very well the absence of specific symptoms of tumours of the gastric wall. In most cases, whatever symptoms may be discovered, these are so vague that attention is not directed to the lesion until bleeding occurs. The management of these lesions poses certain problems as it is often impossible to establish a diagnosis of benign or malignant lesion. A tumour which may appear benign to the radiologist and the gastroscopist,

may well prove malignant on histological examination. Furthermore, malignant it is changes are not always typical and it is sometimes difficult to make a clear-cut histological diagnosis. For these reasons subtotal gastrectomy would seem to be the best and safest way to treat those cases.



Fig. 4.—Barium meal showing the radiological appearance of a benign tumour in the prepyloric region.



Fig. 5.-Lipoma removed from the prepyloric region (numerals are in centimetres).

Should malignancy be suspected a dissection of the lymphatics is unnecessary as these tumours spread by the blood stream. In some instances when the tumour is easily accessible, as in the prepyloric region, a gastrotomy with local removal is permissible provided the lesion is obviously benign. Such was the last case presented, where there was no question about its benign nature, the lesion being a lipoma. Except for those cases, a subtotal gastrectomy is generally the best treatment for benign nonepithelial gastric tumours.

#### SUMMARY

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Benign gastric tumours constitute only 2% of all gastric neoplasms, and 60% of these are of nonepithelial origin. Because of the lack of specific symptoms, diagnosis of these tumours is often delayed until complications such as gastrointestinal hæmorrhages, or obstruction from a welldeveloped lesion become manifest. One benign gastric tumour may be found per one thousand autopsies. After a brief clinical review, three cases are presented which illustrate the various symptoms and signs encountered in such instances.

Because of the difficulty in differentiating a benign from a malignant neoplasm, a subtotal gastrectomy should be done for nonepithelial gastric tumours except in rare cases when the lesion is easily accessible and obviously benign.

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#### RÉSUMÉ

Les tumeurs bénignes de l'estomac constituent seulement 2% de tous les néoplasmes gastriques et 60% de ces tumeurs sont non-épithéliales. A cause de l'absence de symptômes spécifiques, le diagnostic de ces tumeurs est souvent fait tardivement lorsque surviennent des complications importantes telles que des hémorragies ou de l'obstruction gastrique. Pour la même raison, on trouve une tumeur bénigne de l'estomac au cours de mille autopsies. Après une revue clinique de la question, trois cas sont présentés qui illustrent bien les symptômes variés donnés par ces tumeurs.

Le premier patient est un homme de 77 ans qui est mort d'un accident cardiaque et chez qui on a trouvé un volumineux léiomyome de l'estomac avec une ulcération centrale. Ce patient n'avait eu aucun symptôme digestif.

Le deuxième cas est celui d'une femme de 25 ans admise à l'hôpital à la suite d'hémorrhagies gastrointestinales répétées. Un transit digestif montre une très grosse tumeur du tiers supérieur de l'estomac. La guérison complète suit une gastrectomie. L'histologie montre un schwannome

Dans le troisième cas, un homme de 45 ans est admis à l'hôpital pour douleurs épigastriques; on avait déjà porté à son égard un diagnostic d'ulcère duodénal. L'examen radiologique démontre un tumeur mobile et régulière de la région prépylorique. A l'opération un lipome est enlevé après avoir ouvert la muqueuse de la paroi postérieure de l'estomac. Les douleurs épigastriques disparaissent définitivement après l'intervention.

Etant donné la difficulté qu'il y a de poser un diagnostic de tumeur bénigne ou maligne, une gastrectomie sub-totale est conseillée pour une tumeur gastrique non-épithéliale, sauf dans certains cas particuliers quand la tumeur est facile à

enlever et, de toute évidence, bénigne.

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# MEASUREMENT OF BRAIN CIRCULATION TIME BY RADIO-ACTIVE IODINATED ALBUMIN\*

SYLVIA FEDORUK, M.A.† and WILLIAM FEINDEL, M.D.,‡ Montreal

## INTRODUCTION

VASCULAR LESIONS of the brain are a frequent basis for neurological disability and stand third as a reported cause of death in Canada.1 The accurate anatomical diagnosis of some of these lesions by cerebral angiography has served as an impetus for devising neurosurgical approaches for treating intracranial hæmorrhage, aneurvsms, arteriovenous anomalies, and occlusions of major arteries supplying the brain. No satisfactory method has yet been developed, however, to assess regional changes in cerebral circulation produced by these lesions or by the various neurosurgical methods used to treat them.

As pointed out earlier by Moniz,6 cerebral angiography allows an estimation of the relative duration and distribution of radio-opaque media passing through the cerebral vessels. But even with a rapid succession of serial films this approach has limitations for quantitative studies which have been discussed in detail by Greitz.3 These include the difficulty of defining an arterial zero-point and a venous endpoint; the fact that the internal jugular vein is rarely visualized so that carotidjugular time cannot be estimated, and the variations in relation both to the amount of contrast medium used and the timing of its injection.

The indirect nitrous oxide method of Kety and Schmidt<sup>5</sup> has been used to calculate total intracranial blood flow over a 10 minute period. This method, however, is not applicable to the study of transient changes in brain circulation, since the

circuit of blood through the brain occurs normally in a matter of seconds. Recent , the validity of the method has been questioned, particularly in the presence of pathological alterations of cerebral hæm >dynamics.8

Over the past three years we hale studied brain circulation times by using radiation detectors applied over the head and neck of patients during the intravascular injection of radio-active iodinated (human) serum albumin (RISA) given before brain scanning. The method has provided useful information on the speed of blood flow through the brain under normal conditions and in patients with selected disorders of the cerebral circulation.

## PREVIOUS WORK

There are few references in the literature on the measurement of cerebral circulation time using radio-active materials. In 1929 Wolff and Blumgart,9 using radium C and a detector based on the Wilson cloudchamber, found that the circulation time from the common carotid artery to the heart in the cat was six seconds. From this, they estimated that the brain circulation time was of the order of three seconds. They noted that (1) faster cerebral blood flow was associated with an increase in the systemic arterial pressure and (2) slower cerebral blood flow was associated with increased cerebrospinal fluid pressure.

In a study of cerebral blood flow in man, Nylin and Blömer<sup>7</sup> in 1955 used erythr >cytes labelled with thorium B for injection into the internal carotid artery. The two circulation graphs which they show indicate times of eight and of 14 sec. fron the carotid injection to the peak of radi activity measured in serial samples of blocd drawn from the jugular bulb.

Greitz<sup>3</sup> in 1956 compared the circulation times as determined by rapid serial cerebr 1 angiography with those obtained using a radio-active isotope. The determinations were made by two scintillation counter,

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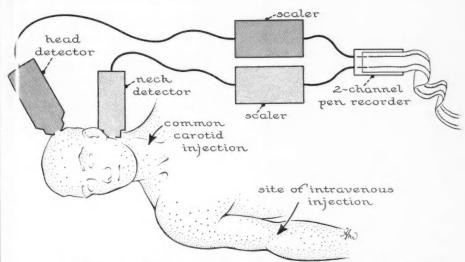


Fig. 1.—Drawing to show the apparatus and sites of radio-isotope injection used in the present studies.

one detector being placed at the level of the jugular bulb and the second tangential to the surface of the head in the parietal region. I<sup>131</sup> in the form of sodium iodide diluted in isotonic saline was injected into the common carotid artery. The resultant traces revealed times of the order of six seconds from carotid artery to parietal veins and eight seconds from carotid artery to jugular veins, with considerable range on either side of these two values.

Crandall and Cassen<sup>2</sup> used a single scintillation detector placed externally over the confluence of the dural sinuses and injected radio-active iodinated albumin into the carotid artery. The carotid-torcular time was noted to range between five and nine seconds in the majority of the patients in their series. As in the study by Greitz, however, no correlation was reported by them between the speed of isotope circulation and the types of intracranial lesions.

#### Метнор

The arrangement of the well-shielded scintillation detectors on the neck and head is shown in Fig. 1. The aperture of the collimator of the neck counter, consisting of a cylindrical hole one inch (2.54 cm.) in diameter and 1.75 in. (4.44 cm.) deep, was positioned over the carotid artery and internal jugular vein. This detector could

also "see" some of the cardiopulmonary circulation. The collimator of the detector which was positioned at various sites on the head had an aperture in the form of a cylindrical hole of one inch (2.54 cm.) in diameter and three inches (7.62 cm.) deep.

The pulses from the two detectors were channelled to two Berkeley scalers. For selected levels of 40, 100 or 200 counts, the scalers provided output pulses which were registered on a chart of a double pen Brush strip recorder running at a speed of 2.5 cm. per second. The counting rate could be determined by measuring the time interval between strip pulses. The resultant

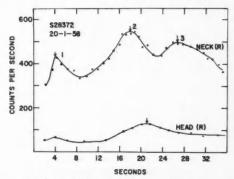


Fig. 2.—Record from patient W.K. showing peaks of radio-activity from the neck and head detectors after intravenous injection of radioisotope.

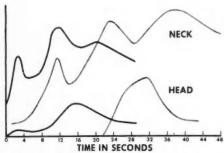


Fig. 3.—Comparison of normal curve (solid line) with curve showing prolonged circulation time in patient with increased intracranial pressure (hatched line).

changes in counting rates with time were then plotted on graph paper.

The RISA was injected from a 1.0 ml. tuberculin syringe into an antecubital vein of the forearm or percutaneously into the common carotid artery. The time of injection was less than one second. Individual injections varied in dosage from 50  $\mu c$  to 200  $\mu c$  and in volume from 0.3 ml. to 1.0 ml. The maximum dosage in any one patient was 400  $\mu c$ .

#### RESULTS

## Normal Circulation Time

Studies were made on 16 patients. The results on two patients were discarded because they were technically unsuccessful. Twenty-seven satisfactory curves for circulation times were available for study. A sample chart is shown in Fig. 2. obtained after the intravenous injection of isotope into the right arm of patient W.K. Three peaks, noted by arrows, are present in the count rate recorded by the neck detector. The exact contribution from each of the various major vascular channels in the neck and head remains to be determined. For the sake of discussion, we have noted them as follows: peak 1 is attributed to the isotope passing through the major vessels of the cardiopulmonary circulation. This is referred to as the "heart" peak; peak 2 is attributed to the radio-active material passing up the four major arteries of the neck and is referred to as the "carotid" peak; peak 3 is due to the RISA passing downward in the neck veins and is referred to as the "jugular" peak.

The change in the count rate recorded by the detector over the right parietal region is shown by the lower curve. The peak on this curve occurs in time between peaks 2 and 3 of the neck counter and s referred to as the "brain" peak. With the isotope dosage and recorder speed in these examples, measurements of the peak maxima were expressed to the nearest half second. In this patient the following times were obtained:

Heart to carotid	14	seconds
Carotid to brain	3	66
Heart to brain	17	66
Brain to jugular	6	46
Carotid to jugular	9	. 66

The results in seven other patients showed similar times for the various phases of the circulation (Table I-A). The diagnosis and the position of the two detectors are indicated. The carotid-jugular times ranged from 7 to 10 sec, with an average of 8.5 sec, for 12 determinations.

## Slow Circulation Time

In patient J.S. (Table I-B), both the arterial and venous phases of the head circulation were prolonged. The total carotid-jugular time measured 15 sec. and in Fig. 3 the record is compared to a "normal" curve in patient H.F. At operation a large glioma of the right temporal lobe in the presence of greatly increased intracranial pressure was disclosed.

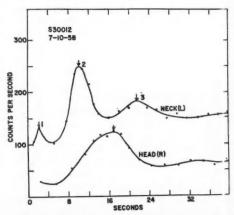


Fig. 4.—Curve from patient R.R. whose slow carotid-jugular time may be ascribed to occlusion of the right carotid artery.

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TABLE I.—Brain Circulation Times Determined by Radioisotope

	(Time	s expressed	in seconds)			
Patient		Heart to carotid	Carotid to brain	Brain to jugular	Carotid to jugular	Counter placement
4 Norma	d time:					
1. L.H.	Basal ganglia cyst	6	3	4	7	RC, TORC
. W.K	? Metastatic brain lesion	11	5	2	7	RC, RH
		14	3	6	9	RC, RH
:. W.H	. Right parietal glioma	8.5	4.5	4	8.5	RC, RH
		8.5	5.5	3.5	9	RC, RH
4. E.W.	Cerebral seizures	12	5	4	9	RC, RH
		13	5	3	8	RC, RH
. W.C.	Right parietal glioma	9	3	3 7	10	RC, RH
(. J.S.	Left carotid stenosis	11.5	4	5	9	LC, LH
. P.Q.	Temporal lobe seizures	15	3	7	10	RC, RH
H.F.	Right frontal glioma	8.5 Carotid	4.5	4.5	9	LC, LH
		injection	3.8	3.4	7.2	LC, LH
Slow to	me:					
1. J.S.	Right temporal glioma	11.5	8	7	15	RC, TORC
		13	8	7	15	RC, ROCC
0. R.R.	Right carotid occlusion	8	7	4.5	11.5	LC, RH
		6.5	6.5	4	10.5	LC, LH
I. W.B.	Right temporal glioma	Carotid injection				
		i (a	2.3	5.7	8.0	
	,	(b	5.5	5.4	10.9	
		ii (a	) 3	8.3	11.3	Without nec
		(b	5.7	8.5	14.2	With neck compression
Rapid	time:					
2. A.J.	Left fronto-parietal angioma	12.5			-	RC, LH
3. A.L.	Left carotid-cavernous fistual	8			-	LC, LH
		8		-		LC, RH
<ol><li>E.M</li></ol>	Frontal angioma	6	4	3	7	RC, LF
		6	4	3	10	LC, LH
		4	6	8	14	LC, LH
		6	5	8	13	LC, RH

RC—right carotid, LC—left carotid, RH—right side of head, LH—left side of head, TORC—torcular, OCC—occipital, LF—left frontal.

In another patient, R.R., who had occlusion of the right carotid artery, the carotid-brain time was prolonged to give a total carotid-jugular time of 11.5 sec. (Fig. 4). A repeat injection with the detector over the normal side of the head gave a value of 10.5 sec.

# Fast Circulation Time

In patient A.J., the carotid angiogram demonstrated a large arteriovenous anomaly in the central part of the left hemisphere (Fig. 5). After intravenous injection of isotope, the maxima of the head and neck curves occurred almost simultaneously (Fig. 6) because of the rapid shunting of arterial blood into the venous circulation. Rapid brain circulation times were also found in patient A.L. who had a post-traumatic carotid cavernous fistula. In both these patients the third peak on

the neck curve occurred at 13 sec. after the arterial peak. This most likely represents the recirculation time rather than delayed venous time.

In patient E.M., with an arteriovenous communication related to an angiomatous malformation between the frontal lobes, the carotid-jugular times were moderately prolonged (Table I-C). Because of the small size of the angioma, the change in cerebral hæmodynamics therefore seemed less significant, although the increased carotid-jugular time suggests a slowing of the venous blood through the remainder of the brain, as noted in rapid serial angiograms by Greitz.<sup>3</sup>

## Intracarotid Injection Curves

Although the measurement of the heartcarotid and carotid-brain phases of the circulation time was of interest, the dilu-

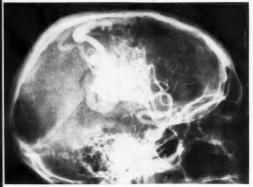


Fig. 5.—Carotid angiogram showing a large angioma in patient A.J. associated with rapid brain circulation time.

tion of the isotope in passage through the cardiopulmonary circulation reduced the sharpness of the peaks of radio-activity passing before the detectors. Sharper peaks were obtained when the isotope was injected directly into the common carotid artery.

In patient H.F. the record following intravenous injection of the isotope in the right arm (Fig. 7) gives the usual triple peak in the neck curve, with the head peak coming between the carotid and the jugular peaks. Intracarotid injection in the same patient (Fig. 8) provided a sharp zero point and the maxima of the head and neck records are more clearly indicated. In addition, as compared to the intravenous injection, a smaller dose of isotope was required to get a satisfactory record.

In another patient, intracarotid injection gave two distinct peaks of radio-activity

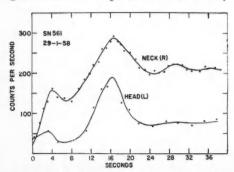


Fig. 6.—Circulation curve from the patient whose angiogram is shown in Fig. 5. Note coincidence of neck and head peaks.

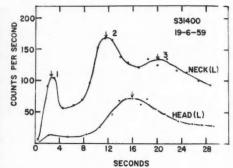


Fig. 7.—Record from patient H.F. after intravenous injection of radio-isotope.

from each detector (Fig. 9). Injection during manual compression of the neck for 30 sec. gave an increase of over three seconds in the carotid-jugular time. This was mainly a delay of the jugular peaks, suggesting a slowing of the venous return from the head (Fig. 10). These results indicate that even transient changes in brain circulation times may be recorded by this method. Further study is required to define more exactly the regional vascular systems of the head and neck responsible for the various maxima in these graphs of radio-activity.

# IMPROVED PLOTTING OF CIRCULATION CURVES

In order to construct the graphs which have been illustrated above, tedious plot-

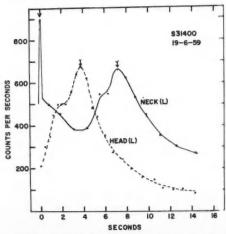


Fig. 8.—Record from patient H.F. after intra carotid injection.

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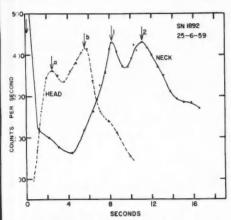
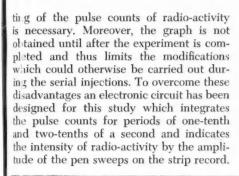


Fig. 9.—Record from patient W.B. after intraca otid injection.



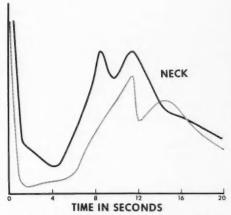


Fig. 10.—Comparison of curves from neck detector before (solid line) and during (hatched line) compression of the neck veins. Patient W.B.

The two types of record, both obtained from a single neck detector after intracarotid injection of isotope, are shown in Fig. 11. The vertical pips along the top line represent the usual method of registration. On the bottom strip is the record from the integrator. The intensity of radioactivity is recorded as a histogram consisting of sections of two-tenths of a second duration. These intervals are convenient for quick measurement of times between any two desired points. The carotid-jugular

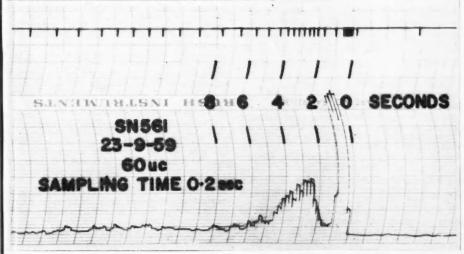


Fig. 11.—Strip record of radio-activity indicated as repetitive pips (upper line) and as a histogram derived from the Moody integrator circuit (lower line), after intracarotid injection of radio-isotope.

interval in this patient measured two seconds, the extremely fast time being related to the arteriovenous shunting from the large angioma, as illustrated in Fig. 6.

#### SUMMARY

The speed of blood flow through the brain has been measured by using multiple radiation detectors to time intravascular radio-iodine as it circulates through the neck and head.

Carotid-jugular times ranged from seven to 10 sec. with an average of 12 values at 8.5 sec.

Rapid circulation times were recorded in patients with arteriovenous shunts and slow times in patients with increased intracranial pressure and carotid thrombosis.

The use of the method to record transient changes in cerebral circulation times is indicated by a record before and during compression of the neck veins.

Intracarotid injection of the isotope gave more accurate information for timing. The use of a rapid integrating circuit allows automatic plotting of curves based on the intensity of radio-activity during 0.1 and 0.2 sec. intervals.

Radio-active iodinated (human) serum albumin has also been used for the determination of cardiac output (Huff et al.<sup>4</sup>) and blood volume. With appropriate detector positioning and blood sampling this supplementary information could be obtained with the same isotope injection used for brain circulation studies and brain scanning.

# ACKNOWLEDGMENTS

The authors are grateful to Professor Norman Moody of the College of Engineering, University of Saskatchewan, for designing the rapid integrator circuit, and to Dr. T. A. Watson, Director of the Saskatoon Cancer Clinic for generous provision of isotope laboratory facilities.

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#### RÉSUMÉ

Depuis plusieurs années, les moyens de diagnostic anatomique précis des lésions vasculaires cérébrales ont été d'une aide précieuse pour la thérapeutique. Cependant, aucune méthode vraiment satisfaisante n'a encore été trouvée pour l'appréciation du courant sanguin circulant dans le cerveau.

C'est pourquoi, les auteurs ont étudié une technique, utilisant des substances radioactives, permettant d'estimer la vitesse du courant sanguin intracérébral; pour ce faire, on place dans la région du cou et sur la tête du patient des détecteurs à scintillation, et l'on injecte dans une veine de l'avant bras ou même directement dans la carotide commune, un centimètre cube de substance radioactive(iode). On peut, par des enregistrements sur plusieurs canaux connaître la vitesse circulatoire entre deux points. Les temps moyens trouvés sont les suivants: de la carotide au cerveau 3 sec.; du cerveau à la veine jugulaire 6 sec.; de la carotide à la jugulaire 9 sec.

Ces temps sont susceptibles de varier d'uns certaines circonstances pathologiques; par exemple, une diminution de ce temps se rencontre chez les patients porteurs de shunts artério-veineux; il sera au contraire allongé chez des malades av int de l'hypertension intracrànienne ou une thromb se carotidienne.

On conçoit que, dans cette méthode, l'équi lement électronique est de toute première importance: certains points à ce sujet sont exposés en détail dans le texte.

Il faut enfin noter que la même injection d'i de radioactif utilisée pour la détermination du ter ps circulatoire cérébral, peut servir, avec un nom re d'enregistreurs suffisant, à déterminer égalem nt le volume sanguin et le débit cardiaque en une seule opération.

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## PRIMARY RETROPERITONEAL TUMOURS\*

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RETROPERITONEAL TUMOURS are often reglected in the differential diagnosis of an abdominal mass. As with other tumours, their successful management depends upon early detection and the application of well I lanned therapy. The author has reviewed I cases of primary retroperitoneal tumour collected from the records of Westminster and Victoria Hospitals over a 10 year period. It should be stressed that these are rimary tumours of retroperitoneal tissues and not tumours arising from the urinary tract, adrenals, pancreas or retroperitoneal portions of the digestive tract.

In 1932, Hansmann and Budd¹ published an excellent paper on the histogenesis of primary retroperitoneal tumours, to which little has been added in the past 28 years. They felt that these neoplasms arose from temnants of the embryonal urogenital apparatus, thus accounting for the diversified histological structure of these tumours. In the present series it would appear that our classification (Table I) tends to support the less popular view², ³, ⁵ that these neoplasms arise from the connective tissue and lymph nodes of the retroperitoneal area.

Thirty of 31 cases were malignant, an incidence of 97%, which is much higher than most reported series. This is in part explained by the fact that this series was collected from a radiotherapeutic centre and will tend to be weighed with malignant tumours. Of these malignancies 87% were sarcomas, the most frequent being reticulum cell sarcoma.

The average age was 53 years with a range of from 22 to 78 years. The sex incidence showed 18 men as compared to 13 women, a slight male preponderance. Early symptoms were characteristically lacking (Table II). The classical picture has been given as one of vague abdominal distress and a palpable mass.<sup>4, 8</sup> A mass was felt

in this series in 65% of cases; the combined frequency of abdominal pain or gastrointestinal complaints amounted to 81% of cases. Anæmia and recent weight loss were common findings. Backache, sciatica and swollen legs were late signs.

The proximity of retroperitoneal tumours to structures such as kidneys, adrenals, pancreas, spleen and colon is paradoxical. It confuses the diagnosis, yet gives a means of diagnosis through the use of flat plates, barium enemas, upper gastrointestinal series and pyelography. In this series there were positive radiological findings in 17 or 55% of the cases (Table III). Pyelography was the most useful radiographic procedure, being positive in eight cases. In five instances it presented as ureteral obstruction with either resultant hydronephrosis or non functioning kidney (Fig. 1a). In three cases a displaced kidney or ureter was found. Although in one instance the barium enema showed obstruction, the usual finding was displacement as was seen also in the upper gastrointestinal series (Fig. 2). Routine flat plate of the abdomen showed an abdominal opacity in four cases.

The two most useful radiological tools are the pyelogram and the routine flat plate. The latter should be examined for altered renal shadow, obliterated psoas shadow, opacity or translucency, and calcification. The pyelogram may show a deflected ureter, distorted calyces or renal rotation.<sup>7</sup>

Despite the abundant clinical findings and the impressive radiological armamentarium, there is an appalling delay in the diagnosis of these lesions. Only four cases were diagnosed within one month of onset of symptoms. The average delay was 20 months with the longest interval being 96 months, or eight years. One cannot help but feel that much of this delay could be avoided if patients with any of the above symptoms be subjected to a thorough radiological investigation beginning with a routine flat plate and pyelogram. An incorrect diagnosis was the rule, the correct clinical

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<sup>&</sup>lt;sup>o</sup>Presented at the Annual Meeting of the Royal College of Physicians and Surgeons of Canada, Montreal, January 1960.



Fig. 1a.—Retrograde pyelogram to show obstructed ureter.

diagnosis being made only twice in 31 cases. The common erroneous diagnoses were genitourinary lesions in seven cases and gastrointestinal lesions in six instances. Eleven patients had no clinical diagnosis. The histological diagnosis was established in 24 cases by biopsy at time of laparotomy, in three cases by surgical removal of the tumour. In four cases the diagnosis was not established until post-mortem. These four case histories are of interest and are presented briefly.

The first patient, a 30 year old man was apparently well until two weeks before death. He presented at hospital with a clinical picture of bilateral pneumonia. Admission chest radiographs showed lung metastases and the patient died within 48 hours of admission. The pathological diagnosis was malignant teratoma, primary in retroperitoneal tissue as careful search elsewhere and serial sections of both testes failed to reveal a possible primary source.

The second case was diagnosed two years before death as carcinoma of the ovary. At post-mortem the true diagnosis of retroperitoneal liposarcoma was evident.

The third case, a pathological fracture of the lumbar spine, and the fourth, a paraplegia, were both subsequently proven to be reticulu n cell sarcomas.

In discussing the management of the e neoplasms, the general consensus is that the only cure is early radical surgical r >moval.2-4, 6-8 This statement must be qua ified. It does not apply to tumours originating in retroperitoneal lymph nodes such as the lymphosarcomas which are often ve v radiosensitive. Hodgkin's granuloma is not amenable to surgical removal. Pack2 of Memorial Hospital, New York, has pro >ably operated upon more of these tumours than anyone, and he feels that radical surgical removal of the neoplasms other than those mentioned above offers the only hope of cure. No one, however, is able to produce any great series of survivors with surgical removal, largely because of the low operability rate. Even Pack in his large series had an operability rate of only 17%. Of 23 cases that were suitable for radical extirpation, 10 were alive and without evidence of disease, four were alive with disease and nine had died of their disease.

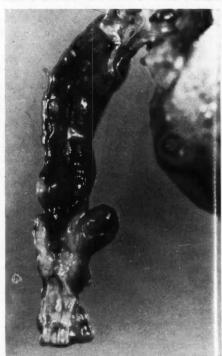


Fig.1b.-Surgical specimen of lesion seen in Fig. 1 t.

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TABLE I.—CLASSIFICATION OF PRIMARY RETROPERITOREAL TUMOURS ENCOUNTERED IN A SERIES OF 31 PATIENTS

	1	Ve	).	0	f	cases
Benign tumours						
Lipoma		,				1
Malignant tumours:						
Reticulum cell sarcoma						10
Liposarcoma						
Fibrosarcoma						5
Lymphosarcoma						4
Undifferentiated sarcoma						1
Hodgkin's granuloma						
Malignant teratoma						1

In this series only three of 31 lesions were operable when seen at laparotomy, an operability rate of 10%. Most of these timours were discovered unexpectedly, a liopsy was taken and the abdomen closed. If a frozen section be done in the operating room it is almost always possible to distinguish benign from malignant tumours, although the exact histological diagnosis may not be ascertained. If malignant, all possible attempts should be made to remove the tumour radically, for undoubtedly the first surgeon to operate upon one of these neoplasms has the best chance to remove it completely.

The following is a summary of the results of the operable cases in which surgical removal was performed.

The first patient was operated upon in 1946, 1948, 1951, and finally in 1952, in each previous instance tremendously large tumours were removed and reported as lipomas. On the last occasion, a diagnosis of liposarcoma was made. Some pathologists including Ackerman<sup>9</sup> feel that all these lipomas are malignant and that the diagnosis is missed. This patient had survived a little over six years with a diagnosis of lipoma but less than a year after the diagnosis of liposarcoma was established. This case illustrates the tendency for retroperitoneal lipomas to recur and to become malignant with time.

TABLE II.—CLINICAL FINDINGS IN RETROPERITONEAL TUMOURS

		No. of cases	%
1.	Abdominal mass	20	65
	Anæmia	16	52
	Abdominal pain	13	42
4.	Gastrointestinal complaints	12	39
	Backache and/or sciatica	12	39
	Weight loss	12	39
7	Swollen legs	8	26



Fig. 2.—Displacement of stomach by retroperitoneal tumour as seen on gastrointestinal series.

In the second case, it was felt that the liposarcoma had been completely removed but the patient died 13 months later out of hospital. Unfortunately no autopsy was done so that we can only assume that he died of his disease.

The third patient had only about 75% of the tumour removed because of technical difficulty, profuse bleeding and operative shock. Although this is a depressing picture of surgical interference, one cannot help but feel that better results could be achieved with earlier diagnosis and more radical surgery.

Table IV is a list of the many associated surgical procedures necessary in the management of these tumours. In all there were 29 operations with three deaths, an operative mortality of about 10%. The first operative death had had a Mikulicz colostomy for bowel obstruction due to a reticulum cell sarcoma; the man died 30 days later of sarcomatosis. The second patient underwent a nephro-ureterectomy for urinary obstruction on the basis of a Hodgkin's granuloma and died 67 days later from a suppurative pyelonephritis. The third case involved a laminectomy for spinal cord decompression but the patient died on the 11th postoperative day of massive pulmonary embolism.

Some type of radiotherapy was frequently used in this series in part because of the

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TABLE III.—RADIOLOGICAL FINDINGS IN RETROPERITONEAL TUMOURS

Procedure	Finding	No. of	cases	13
1. Pyelogram	Ureteral block	5	8	11
2. Barium enema	Obstruction	4	5	
3. Upper GI series.	Displacement	-/	4	
4. Flat plate	Opacity		4	
5. Vertebral column	Pathological fracture		2	
6. Myelogram	Extradural block		2	

presence of a radiotherapeutic unit in this centre but also because the following were regarded as indications for radiotherapy.

- 1. Inoperable tumour.
- 2. Recurrent tumour.
- 3. Residual tumour.
- 4. Radiosensitive tumour.

Before 1951 conventional radiotherapy (250 kv. range) was used but since 1951 cobalt 60 beam therapy has been employed almost exclusively.10 (Tumour doses are approximately 2500r-3500r.) Cobalt 60 beam therapy was used as the sole means of therapy in nine cases and combined with surgery in two cases. Cobalt 60 beam to primary and deep x-ray to suspected secondary fields were used in six cases. Deep x-ray was used alone in three cases and once was combined with surgery. In summary, some form of irradiation was employed in 21 cases with cobalt being used alone or in combination in 17 cases.

The prognosis of retroperitoneal malignancies is rather dismal. In this series of 30 malignancies there are six survivors. For statistical purposes there are only five survivors as the sixth is only three months from time of palliative surgery. The average survival is 27 months with a range from nine to 50 months. It is interesting that all five survivors received cobalt 60 beam therapy as the only method of treatment. In addition there did not appear to be any good correlation between the histology of

TABLE IV.—Surgical Procedures Employed in Management of Retroperitoneal Tumours

Laparotomy and bi	0	DS	33	7						,							1
Removal of tumour																	
Nephrectomy											è						
Laminectomy																×	
Appendectomy												,					
Gastrectomy														·	÷		
Gastroenterostomy																	
Cholecystectomy		ĺ.											j			į	
Colostomy																	
Vertebral biopsy				+						,				,			

the tumour and the survival time of the patient.

Twenty-four of 30 patients died. The best palliation was achieved in the group of 11 cases that had cobalt 60 bear therapy, with an average palliation of 14 months. The five patients receiving palliative surgery only did no better than the untreated group; both had an average survival of two months.

In conclusion, the following points should be stressed: Primary retroperitoneal tumours are not a rarity: 31 cases over a 10 year period have been reviewed. There is too great a delay in diagnosis. This may be decreased by keeping this possibility in mind, by the intelligent use of radiography and by earlier surgical exploration.

Despite the general consensus, the delay in diagnosis (20 months) and the extremely low operability rate (10%) preclude early radical surgical attack in most instances. In this series radiotherapy produced five survivors and appeared to be the best form of palliation.

#### ACKNOWLEDGMENTS

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The authors wish to thank the Cancer Clinic at Victoria Hospital, London, Ont., for the use of their data, and are especially indebted to Dr. Lois M. Myers for her constructive criticism. We are also indebted to Mr. Don Pulham and the Photographic Department of Westminster Hospital, London, Ont.

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#### RÉSUMÉ

Les tumeurs rétropéritonéales sont souvent négligées dans le diagnostic différentiel des masses abdominales. Comme pour toute tumeur, le succès thé rapeutique dépend d'un diagnostic précoce et d'un traitement convenablement appliqué. Le présent article est une revue de 31 cas de tumeurs rétropéritonéales primitives, c'est à dire à l'exclusion de toute tumeur d'origine urinaire, surrénale, pancréatique ou digestive; 97% de ces cas étaient

malins et 87% étaient des sarcomes. L'âge des patients variait entre 22 et 68 ans (âge moyen 53).

Les symptômes du début sont très vagues: le malade se plaint d'une "sensation" dans le ventre, et généralement une masse est palpable; un certain degré d'anémie et d'amaigrissement est assez fréquent. Les signes tardifs sont; des douleurs dans le dos, de la sciatique et une enflure des jambes. Radiologiquement, les deux examens qui se révélèrent les plus utiles furent la radiographie à vide et la pyélographie. Le diagnostic est difficle car les statistiques montrent que seulement quatre cas furent reconnus dans un délai d'un mois après l'apparition de la maladie. Les erreurs les plus fréquentes sont les confusions avec des lésions de l'appareil urinaire ou du tractus digestif rétropéritonéal. Dans quatre cas, le diagnostic ne fut fait qu'à l'autopsie.

Le traitement de choix est évidemment l'ablation de la tumeur si possible; ceci ne s'applique pas aux tumeurs. provenant des ganglions lymphatiques rétropéritonéaux (métastases, lymphosarcome etc.) Il faut signaler que la biopsie extemporannée faite par un anatomopathologiste dans la salle d'opération avec l'aide de coupes en congélation est du plus haut intérêt en ce qui concerne la conduite de l'intervention. Toutes les statistiques sont données ici sous forme de tableaux. D'une façon générale, on doit se souvenir que les tumeurs rétropéritonéales ne sont pas une rareté; que leur diagnostic exact est souvent retardé trop longtemps; et enfin, que seul un diagnostic précoce peut permettre une thérapeutique efficace.

FELLOWSHIP OF SURGEONS. A History of the American College of Surgeons. Loyal Davis, M.D. 523 pp. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1960. \$11.50.

This is a story of not only the American College of Surgeons but of its official journal, Surgery, Gynæcology and Obstetrics and The Clinical Congress of Surgeons of North America which supplied the urge to form the College. It tells of the remarkable part which Franklin K. Martin and a group of outstanding surgeons of his generation played in the early years of the college, spurred as they were, by a desire to improve the art and science of surgery and, equally important, the ethics of surgical practice. These were the formative years in modern surgery, and surgical science was progressing more rapidly than the training of surgeons. As a result of this and financial inducements, operative work was being undertaken by those whose training did not justify their accepting the responsibilities involved. The ethics of practice left much to be desired and no medical organization in the United States or Canada had thus far made any serious attempt to improve them. Hospitals had been content to provide accommodation for patients and did

not consider that they had any responsibility to see that the patients received proper care.

As the author says in the foreword "The story of the American College of Surgeons is that of the development and progress of surgery in America. No other medical organization, voluntarily entered into by its Fellows, has exerted such a profound influence upon the discipline and art of surgery in the United States." Dr. Loyal Davis is vice-chairman of the Board of Regents of the American College, and Editor of Surgery, Gynæcology and Obstetrics, and in addition has been associated intimately with the affairs of the College for many years and is therefore well qualified to undertake the task of writing its history. The story needed to be told and it has been done well. Every fellow of the American College should read this book as indeed should fellows of other colleges with similar ideals. The reviewer suggests to prospective readers that their enjoyment of this book will be increased by first reading the recently published history of the Royal College of Surgeons of England by Zachary Cope, since this much older organization influenced the thinking of those responsible for founding the American College.

## DEVELOPMENTAL COXA VARA

A NEW TYPE OF INTERNAL FIXATION FOR SUBTROCHANTERIC OSTEOTOMIES. REPORT OF THE CONDITION OCCURRING IN A MOTHER AND TWO DAUGHTERS. H. R. CARTER, M.D., Victoria, B.C. and C. C. VITALE, M.D., Brooklyn, N.Y., U.S.A.\*

This paper presents the authors' experience with developmental coxa vara at Kings County Hospital between 1956 and 1959.

## DEFINITION

The normal neck-shaft angle, or angle of inclination, is between 125° and 130° in adults. In children this angle varies from 140° to 160°. In coxa vara the angle is less than 120° and usually approaches the right angle. In severe cases it is even less than 90°.

Many conditions may cause coxa vara. The following is a list of the main causest

- 1. Idiopathic: (a) congenital; mild or severe coxa vara with associated congenital anomalies such as dislocation of the hip, faulty development of the femur, cranial cleidodysostosis, etc. (b) developmental; progressive, usually appearing between the ages of two and six years, with characteristic roentgenological features.
- 2. Rachitic: usually associated with active rickets.
- 3. Adolescent: secondary to slipped capital femoral epiphysis.
- 4. Traumatic: usually following fracture of the femoral neck.
- 5. Inflammatory: secondary to tuberculosis or other infection.
- 6. Other underlying bone diseases: osteogenesis imperfecta, cretinism, dyschondroplasia, Paget's disease, etc.
- 7. Capital coxa vara: occasionally seen in severe osteoarthritis and Legg-Perthes disease.

We are concerned primarily with the developmental type. The condition is seen usually between the ages of two and six years and its incidence is one per 25,000 live births.18 There is one case of developmental coxa vara for every 14 dislocated

hips.19 Right and left sides are equally nvolved, and in one-third of all cases the lesion is bilateral. A familial history is occasionally present and is too convincing to be considered coincidental;1, 12, 18, 15 23 however there is only one previous report of direct parent-child involvement.18 Cur series includes a mother and her two daughters (Figs. 1a, b and c).

## ETIOLOGY AND PATHOLOGY

Various theories have been advanced regarding the etiology of developmental and congenital coxa vara.2, 10, 13 Pathological studies of tissue removed from the affected portion of the femoral neck have been few, varied and inconclusive.4, 8, 9, 16, 21, 24

It is interesting to note that in the formation of the normal femoral neck, a bony medial process develops and extends upwards towards the femoral capital epiphysis (Fig. 2). In developmental coxa vara this orderly formation fails to occur, probably as a result of delayed or faulty ossification in the upper epiphysial plate. Since the femoral neck does not have a normal bony framework it cannot withstand weight bearing stresses. The reason for this failure in development is not known.

## SIGNS AND SYMPTOMS

Patients usually complain of a painless limp, and early fatigue on walking and running.

Signs consist of a short lower extrem tv and a limp, with waddling gait particularly in bilateral lesions. Abduction and extension of the hip is limited, but not by p.otective muscle spasm or pain. There is 10 telescoping, the Trendelenburg test is positive, and lumbar lordosis is severe in ilateral lesions.

## RADIOGRAPHIC FINDINGS

The roentgenographic findings in cavelopmental coxa vara are typical and cox

From the Orthopedic Service, Kings County Hospital, Brooklyn, N.Y. †From Elmslie, modified by Finby, 11 Lancet, 1: 410, 1907, by kind permission of the publishers.

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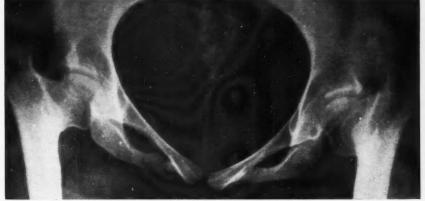
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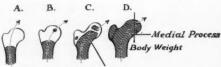
Fig. 1a



Fig. 1b



Figs. 1a, b and c.—Typical developmental coxa vara in two sisters (Figs. 1a and b) and their mother (Fig. 1c). The arrow in Fig. 1b points to the classical triangular "fragment".



Medial Process

Fig. 2.—Formation and function of the medial process. A. At birth, head and neck are cartilagenous, thick and short: they are not easily injured. B. At age 11 months. Centre for head appears. C. At age five and one-half years, medial process is forming. D. At twelve years, the shaft has grown to form neck. (After Elmslie, R. C.: Lancet, 1: 410, 1907. By kind permission of the publishers).

sistent. There is a reduction in the angle of inclination to approximately 90°, with a radiolucent line through the femoral neck just distal to the epiphysial line. These two lines form an inverted Y which isolates a triangular piece of bone in the inferior aspect of the neck.

Less fundamental features are:

1. The radiolucent line in the femoral neck. This line, frequently referred to as the vertical fissure, represents an area of

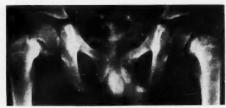


Fig. 3a



Fig. 3b

Figs. 3a and b.—A man was first seen at the age of four years with painless limp and waddling gait. Roentgen examination: a. Age four years. Note the triangular metaphysial bone fragments bilaterally: b. Age 28 years. The right femur is displaced upward forming a pseudoarthrosis with the ilium. The demineralized femoral head remains in the acetabulum. The deformity of the left hip is less marked; the femoral head is completely fused with the femur. Case report by courtesy of Homer Graham, M.D., Burbank, California. Roentgenogram illustrations reproduced from Radiology, 63: 59, 1954, by kind permission of the publishers.<sup>6</sup>



Fig. 4a



Fig. 4b



Fig. 4c

Figs. 4a, b and c.—This girl first seen in 1927 at age five years, presented with painless l mp and shortening of the right leg. There was an elevation of the greater trochanter of the r ght femur. Roentgen examination: a. At age five ye its Moderate coxa vara. Note the marked shorter ing of the femoral neck. The triangular bone fragn ent (arrow) results from the extension of the epiphysial cartilage into the metaphysis: b. Increasing deformity: c. Age 13 years. Extreme coxa vara with pronounced femoral shorten in the femoral head is fused to the femoral nick at the level of the lesser trochanter. Roentge in familiustrations reproduced from Radiology, 33: 59, 1954, by kind permission of the publishe s.6

fil rocartilaginous tissue that is incompletely ossified. The direction, width and formation of this line is inconstant, but is always more vertical than the normal epiphysial plate. Occasionally there appear to be several lines close together producing an uneven appearance. In other cases, multiple small areas of ossification may form a hazy appearance with no definite trial gular section present.

2. The epiphysial line. This line is frequently difficult to define. Superiorly it tends to blend with, and form part of, the virtical fissure. Inferiorly it may be thinner

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3. The femoral head. The head of the femur is more translucent than the pelvis or greater trochanter. In old neglected lesions, real non-union, with loss of con-

tinuity, can occur. Osteophytosis is absent.

4. The "fragment" of bone in the femoral neck. This tissue is not a fragment in the sense of being a loose piece of bone, but rather represents a poorly ossified portion of the primary fibrocartilaginous defect. As a lesion progresses the "fragment" frequently acquires bony fusion with either the head or the neck.

5. The greater trochanter. In untreated adolescents and adults the greater trochanter has a peaked appearance as if it were being pulled up. A steep curve runs down to the neck.

6. The neck of the femur. The femoral neck varies in length from normal to extremely short. There is no suggestion of increased anteversion.



Fig. 5a



Fig. 5b



Fig. 5c

Figs. 5a, b and c.—Illustrative examples of frequent complications resulting from the application of a spline, a. Undercorrection: b. Overcorrection: c. Penetration of the joint.

#### PROGNOSIS

Spontaneous arrest is rare. Once established, developmental or congenital coxa vara tends to progress. Untreated lesions proceed to severe deformity and disability (Figs. 3a and b, and Figs. 4a, b and c).

#### TREATMENT

Acceptable treatment today is subtrochanteric osteotomy with the object of correcting the shaft-neck angle.<sup>5</sup> Non operative management with abduction is ineffectual. Various surgical techniques have been employed to accomplish this correction.

Early in this series we used splines<sup>7</sup> for internal fixation, and in one case a Steinman pin. <sup>15</sup> Considerable difficulty was encountered when it was found necessary to remove the spline after a faulty drive,

and the local operative complication rate was unsatisfactory (Figs. 5a, b and c). In the case where a Steinman pin was used the position was lost postoperatively.

Because of these complications we tri dusing a miniature Jewett nail (Fig. 6). The ease with which the procedure was accomplished was surprising. We have employed this method in our last six interventions on hips without complications.

TABLE I.—Complications of Spline Fixation in 10 Hips

** 1 ( 1 ()	Marin -
Undercorrection of angle of inclination	
Overcorrection of angle of inclination	
Penetration of hip joint	
Subtrochanteric fracture of femur	
Excessive duration of procedure	
Total	i

## OPERATIVE TECHNIQUE

The technique consists of driving a small Jewett nail over a guide wire through a lateral incision (Figs. 7a and b). A roent-genogram at this point will show the amount of correction that will be obtained (angle "C" in this diagram) and allow choice of a nail of suitable length. A subtrochanteric osteotomy is performed and the shaft is fixed to the nail with screws. Placing the proximal fragment into the medullary canal of the distal fragment increases stability and preserves length.

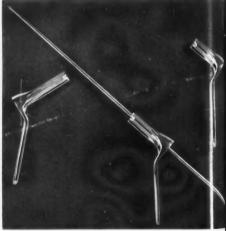


Fig. 6.—Miniature Jewett nail. Cannulated stabless steel tri-flanged Jewett nail which fits standard Smith Petersen nail driver, Lengths 1¼ in. 1½ in., 1¾ in. (Photograph with compliments of Zimmer Manufacturing Company.)

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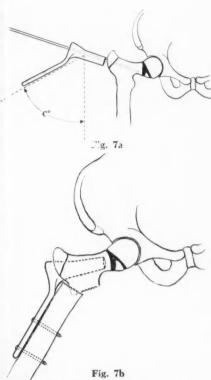
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Figs. 7a and b.-a. Guide wire in position. Illustrations show accurate determination of amount of correction, angle "C": future position of internal fixation: correct length of nail to be used: b. Proximal fragment rests in medullary canal of distal fragment. This provides stability, maintains length and allows good fit with the nail. The proximal fragment is easily controlled with a Smith Petersen nail driver.

## RESULTS

This method has been used for correcting six hips. No complications of this form of internal fixation have occurred, and the operative time and difficulty have been reduced. Adequate correction of the angle of inclination was achieved and has been maintained.

#### CASE REPORTS

Figs. 8a, b, c and d, show a coloured boy aged three years and nine months, and one year after surgical correction of bilateral developmental coxa vara. He had the typical signs preoperatively. These photographs reveal the improvement resulting from operation. The Trendelenburg test is negative bilaterally and his gait is normal.

Figs. 9a and b show roentgenograms of a ten year old coloured boy, who complained of painless limp of one year's duration. The left leg was one inch short and presented the classical signs. No shortening is left after the procedure. Note that the nail did not cross the epiphysial line.

A four year old coloured boy presented with a painless limp of indefinite duration. Examination revealed a % in. shortening, loss of abduction and positive Trendelenburg test. One year after operation (Figs. 10a and b) the physical examination is normal.

## DISCUSSION

Developmental coxa vara is a localized condition of the hip of unknown etiology. Normal bony support for the femoral capital epiphysis fails to develop. Instead, there is a mixture of abnormal bone and cartilage in the femoral neck which cannot withstand the shearing force of weight bearing.

In the literature reviewed 17 familial cases were noted. Francke12 reported involvement of three siblings in a family of four, and Roberts23 reported coxa vara in identical twins. The only direct parentchild relationship was in Johanning's series,18 where a father and daughter were affected. (We have reported another instance of parent-child involvement in which a mother and her two daughters have typical developmental coxa vara). In a consideration of the etiology, these cases must be kept in mind.

We believe that surgery should be done early, and is certainly feasible in the three to five year old age group. Early operative correction eliminates the need for reconstructive procedures, and avoids the serious obstacle of soft tissue shortening encountered in some older children.14 Most

authors share this view.3.24

It is unnecessary to cross the epiphysial line with internal fixation. The relationship of the head to the neck will not change after adequate correction. The deformity did not recur in any of our cases. This is substantiated by various authors.8, 12, 20

Aseptic necrosis of the femoral head or epiphysial damage is not a problem. Subtrochanteric osteotomy does not interfere with the blood supply to the proximal part of the femur. In our patients no aseptic necrosis occurred regardless of the type or



Fig. 8a



Fig. 8b



Fig. 8c

position of the internal fixation, and this complication was not mentioned in any of the articles reviewed.

Premature closure of the femeral capital epiphysis appears to occur in corrected cases, taking place around eleven years of age. However, we believe this to be due to the beneficial effect of compression on the corrected neck, and that it is a desirable event having no direct connection with the surgical procedure or the type of internal fixation. It is interesting to note that a Smith-Petersen nail without osteotomy did not close the gap.<sup>19</sup>

In treating coxa vara by subtrochanteric angulation osteotomy, the miniature Jewett nail has several advantages over other forms of internal fixation:

1. accuracy of correction



Fig. 8a



Fig. 8b



Fig. 8c

- 2. fewer complications
- 3. ease of insertion, or extraction
- choice of crossing or avoiding the epiphysial line with internal fixation.
- 5. strong internal fixation that will maintain operative correction.

## SUMMARY

- 1. Internal fixation of subtrochante ic osteotomies for coxa vara can be done ac equately and easily with the miniature Jewett nail.
- 2. Complications are less likely to occur with this form of internal fixation.
- 3. Three cases of a familial nature, favolving a mother and two daughters, are reported.

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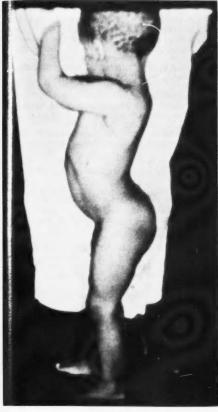


Fig. 8d



Figs. 8a, b, c and d.—Preoperative views on the left, postoperative on the right, a. Roentgenograms of typical case of bilateral developmental coxa vara. b. Usual marked loss of abduction of the hips and improved abduction following operation, c. Flexion deformity and definite postoperative improvement, d. Marked lumbar lordosis corrected after bilateral osteotomies.

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Fig. 9a



Fig. 9b

Figs. 9a and b.—a. Ten year old boy presenting with a unilateral lesion. b. Nail does not cross epiphysial line. Outer cortex of proximal fragment placed in medullary canal of distal fragment.



Fig. 10a



Fig. 10b

Figs. 10a and b.-Unilateral developmental coxa vara in a four year old child, a. Film taken in operating room showing the amount of correction and the future position of nail, b. Film taken one year later.

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## RÉSUMÉ

Cet article résume les expériences et les conclusions des auteurs sur cette difformité: l'age moyen des cas qu'ils ont traités variait entre deux et six ans; la fréquence est d'un cas sur 25,000 naissances. Les côtés gauche et droit sont indifféremment atteints.

De nombreuses théories ont été avancées concernant la pathogénie et l'étiologie de la maladie: peu sont satisfaisantes, et il faut signaler que l'étude histologique de fragments osseux prélevés dans ces cas n'apporte malheureusement que peu de renseignements.

Du point de vue symptomatologique, les patients se plaignent en général d'une fatigabilité anormale à la marche. L'extrémité inférieure est plus courte et une claudication existe, surtout dans les cas bilatéraux. L'abduction et l'extension de la hanche sont limitées sans qu'il y ait aucune contracture musculaire ni aucune douleur. Le test de Trendelenburg est positif et la lordose lombaire très forte dans les cas bilatéraux.

Les signes radiologiques dans la coxa vara acquise sont caractéristiques et constants: il y a une diminution de l'angle d'inclinaison jusqu'à environ 90° avec présence d'une ligne claire p issant à travers le col fémoral, juste en dessous de la ligne épiphysaire; souvent, la tête elle mê ac montre une moins grande densité aux rayons X que le trochanter.

L'évolution de l'affection est continue, et il n'a jamais été noté d'arrêt spontané. Le trai cment non opératoire est inefficace. La vérita le thérapeutique est l'ostéotomie sous-trochan é-rienne visant à corriger l'angle du col: une technique opératoire est décrite ici en détail (utili a-tion d'un clou de Jewett). Trois des cas discut s, comportent un contexte familial.

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## CARBON DIOXIDE NARCOSIS IN THE POSTOPERATIVE PERIOD

R. J. BAIRD, B.Sc.(Med.), M.D., F.R.C.S.[C] and W. G. BIGELOW, M.D., M.S., F.R.C.S.[C], Toronto

It any consideration of the problem of it adequate postoperative pulmonary venti ation, the attention of the surgeon is usually centered on oxygen. It is well known that significant hypoxia may be present while cyanosis is minimal or absent. Every effort is made to provide a patient who has a mptoms and signs of hypoxia with an it creased oxygen supply and an adequate a rway.

Inadequate ventilation also leads to an accumulation of carbon dioxide and may result in respiratory acidosis and carbon doxide narcosis. The clinical picture of this condition is frequently not recognized. The purpose of this article is to stress the dangers of carbon dioxide retention in the postoperative period. Our interest in this problem was stimulated by experience with a patient recently admitted to the Cardiovascular Service of the Toronto General Hospital.

#### CASE REPORT

The patient, a man of 66, was in good health apart from obesity and mild hypertension. He had no evidence of pulmonary disease. On September 19, 1958, an aneurysm of the abdominal aorta ruptured into the retroperitoneal space. The resulting pain and hypotension were treated vigorously at his local hospital, where he was given morphine and transfused with 5000 c.c. of citrated blood. On arrival at the Toronto General Hospital 15 hours after the onset of his symptoms, he had a huge abdominal mass and his blood pressure was 95/70 mm. Hg. He was operated upon immediately and the ruptured aortic aneurysm replaced by an aortic prosthesis. A further 6500 c.c. of citrated blood were required during the operation. The paramedian incision extended from the xiphoid process to the pubis and at the end of the operation the abdomen was supported by an abdominal binder.

The patient's postoperative course was uneventful for four days. Blood pressure remained around 160/100 mm. of mercury. His breathing was shallow because of the long incision and the

abdominal binder, so he was kept in an oxygen tent. During this period digitalis, penicillin and streptomycin were administered. On the fifth day, his condition began to deteriorate. He complained of severe headache, became very drowsy and would not answer when spoken to. His breathing became more shallow and periods of apnœa occurred. Transient weakness and twitching of the right arm was noted. He became slightly cyanosed despite the continued use of the oxygen tent. Physical examination and portable roentgenograms revealed the presence of bronchopneumonia and mild pulmonary congestion. Blood pressure was then 115/65. Frequent naso-tracheal suction was used, but tracheo-bronchial secretions were not excessive.

On the 10th postoperative day, we considered the possibility of respiratory acidosis and carbon dioxide narcosis resulting from inadequate ventilation. An arterial puncture was performed and blood taken for the determination of pH and total carbon dioxide content. The pH was lowered to 7.26. The determination of total carbon dioxide was difficult to obtain in the central laboratory at this time, so we accepted a determination of arterial carbon dioxide combining power; it was raised to 36 mEq./l. Serum chloride was 88 mEq./l.; serum sodium and potassium were normal. These reports confirmed the presence of a severe respiratory acidosis which had been present for several days.

The patient's ventilation was assisted by a Bennett resuscitator providing intermittent positive pressure. His mental state improved immediately. Because the face mask was uncomfortable and tracheal suction difficult, a tracheotomy was performed. Intermittent periods of apnœa continued to occur, so the machine was kept on automatic control for 10 days

10 days.

The venous carbon dioxide combining power was followed daily and had reached a normal range by the 15th postoperative day (Fig. 1). On the 20th postoperative day, the patient was able to trigger the resuscitator by his own inspiratory efforts. By this time, however, he had become quite dependent on its assistance, and it required a further eight days of intermittent use to wean him from it. His lungs were now completely clear to physical and radiological examination. There was no sign of heart failure. He was mentally bright and

<sup>\*</sup>Cardiovascular Division, Toronto General Hospital.

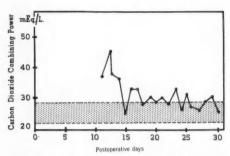


Fig. 1.—The carbon dioxide combining power in the case described. The first determination is from arterial blood, the others from venous blood.

alert and no further neurological abnormalities developed. Before he was discharged his pulmonary ventilation (tidal volume, vital capacity, and maximum breathing capacity) was tested at the pulmonary laboratory of the Toronto General Hospital and was found to be normal. We believe that the inadequate ventilation and subsequent respiratory acidosis and carbon dioxide narcosis in this patient resulted from postoperative bronchopneumonia, the abdominal binder, and the high abdominal incision.

#### EFFECTS OF CARBON DIOXIDE RETENTION

## (a) Effect on Acid-Base Balance

The resting basal carbon dioxide production (CO2, H2CO3, HCO3) is approximately 13,000 mM. per day.2 This level rises quickly with exertion and with heavy work is more than doubled. The lungs are responsible for the elimination of the great bulk of this acid metabolite and 24 minutes of severe ventilatory embarrassment can cause the arterial pH to drop to 7.0 or lower.2 The characteristic plasma pattern of this acute respiratory acidosis is that of a rising total carbon dioxide, a rising carbon dioxide tension and a rapidly falling pH (Fig. 2). The carbon dioxide combining power will rise with renal compensation (excretion of dihydrogen phosphate, carbonic acid, chloride and ammonium, and maximal tubular resorption of sodium bicarbonate) and formation of acid urine (Fig. 3). This renal compensation to respiratory acidosis is slow and takes from 12 to 18 hours to manifest itself. Thus there is no significant change in the carbon dioxide combining power in acute respiratory acidosis. Carbon dioxide combining power is a measure of the amount of carbon dioxide that the blood would car v if respiratory factors were normal and tle alveolar carbon dioxide tension were mai 1tained at 40 mm, of Hg. Although this determination is of great value in metabol c acid-base change in which there are fixed ion gains and losses, it is of much less value when respiratory factors are at fau t. Only when the carbon dioxide retention has persisted for several days (as in the cale reported above) will the carbon dioxice combining power be significantly elevate l. It is unfortunate that the valuable determination of total carbon dioxide content is not more readily available in hospital laboratories. The arterial carbon dioxide tension is calculated from the pH and total carbon dioxide content by using the nomogram of Van Slyke and Sendroy.

## (b) Effect on the Cardiovascular System

The clinical response to a short period of carbon dioxide retention is a rise in blood pressure. Where the onset of retention is more insidious blood pressure may not change.

A moderate rise in arterial carbon dioxide tension produces a reflex constriction of the systemic and pulmonary arterioles and a rise in the systemic and pulmonary blood pressure. The capillaries of the skin dilate and the patient appears flushed. The cerebral arterioles dilate and the increased cerebral blood flow contributes to a rise in intracranial pressure.

The rising carbon dioxide tension directly affects the heart by weakening the myocardial contraction and by producing ventricular irregularities.<sup>3</sup> This combination of increased vascular resistance and decreased cardiac efficiency may lead to congestive heart failure.

## (c) Effect on the Central Nervous System

A rise in the arterial carbon dioxice tension has a marked effect on the activity of the respiratory centre. A mild rise stimulates the respiratory centre, but chronic retention causes it to become relatively insensitive to carbon dioxide. The respiratory drive then becomes dependent

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# Acute Respiratory Acidosis

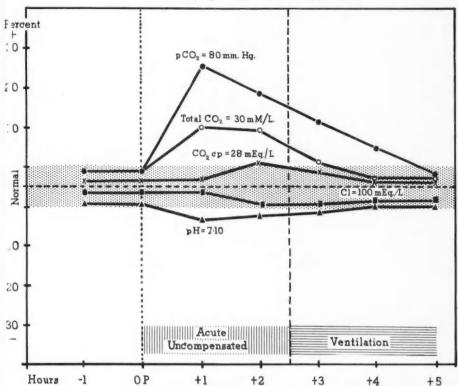


Fig. 2.—In acute respiratory acidosis renal excretion of acid does not keep pace with the rapid accumulation of carbon dioxide. There is a quickly mounting acidosis with a falling pH, a rising total carbon dioxide content and carbon dioxide tension, and a normal carbon dioxide combining power. (Adapted with permission from Moore, F. D.: New England J. Med., 258: 377, 1958.)

on reflexes produced by the effect of hypoxia on the chemoreceptors in the carotid and aortic bodies. If the hypoxia of a patient with chronic carbon dioxide narcosis is suddenly relieved by the passive administration of oxygen, ventilation becomes reduced further and the arterial carbon dioxide may rise to toxic levels. The arterial carbon dioxide tensions productive of narcosis, convulsions, coma, and death are shown in Table I.

The narcotic properties of carbon dioxide are well known. In 1937, Waters successfully anæsthetized three patients with 30% carbon dioxide; he discontinued the practice after one suffered a severe convulsion. The procedure of taking eight to 12 breaths

of 30% carbon dioxide will raise the arterial carbon dioxide tension of an adult man to more than 100 mm. Hg and produce loss of consciousness.<sup>4</sup>

A slower rise in carbon dioxide tension will produce bizarre neurological phenomena such as shown in the case reported above (Table II). Drowsiness and headache are characteristic. Muscular weakness, hemiparesis, and tremors may develop. This tremor, "asterexis", is similar to the "liverflap" of hepatic disease.<sup>5</sup> The intracranial pressure rises and may cause papillædema. These findings have occasionally led to the intensive neurological investigation of patients with carbon dioxide retention, in an attempt to rule out intrinsic brain lesions.

# Chronic Respiratory Acidosis

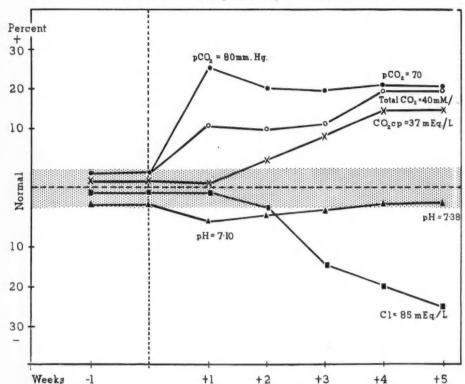


Fig. 3.—Slowly, with renal compensation, there is a restoration of pH toward normal. Now there is a high total carbon dioxide content, a high carbon dioxide tension, and also a high carbon dioxide combining power. (Adapted from Moore, F. D.: New England J. Med., 258: 377, 1958.)

## CAUSE OF CARBON DIOXIDE RETENTION

Although surgeons often encounter carbon dioxide retention after injuries to the airway and thorax, the authors feel that it is most often encountered in the recovery room during the postoperative period. Pulmonary ventilation may be made inadequate by heavy sedation or by the continued action of the depressant drugs used by the anæsthetist. Thoracic or high abdominal incisions, abdominal distension or abdominal binders. excessive bronchial secretions or atelectasis and pneumonitis - all can contribute to its development. The arterial carbon dioxide tension was well above normal in 25% of a series of 100 routine cases examined in the recovery room by W. K. Hamilton.6

Carbon dioxide retention appearing several days after operation is seen in patients suffering from chronic pulmonary hypoventilation. This hypoventilation may be produced by diseases of the lung, such as emphysema; diseases of the thorax, such as kyphoscoliosis; or by neuromuscular disorders, such as poliomyositis. Recently, there have been reports of its presence in the very obese. Any patient suffering from such a disorder will have an increased risk of developing acute seve e carbon dioxide retention postoperatively.

A state of metabolic acidosis may lepresent following a prolonged surgicul procedure. Hypotension will reduce the effectiveness of the kidneys and hypoxawill lead to the accumulation of lactic and pyruvic acids.<sup>2</sup> If all available buffers a e

TABLE I.—THE EFFECTS OF CARBON DIOXIDE ON BRAIN FUNCTION

Arterial carbon d oxide tension ir mm. Hg.	Brain function
3 i - 45	Stimulation of respiratory centre Narcosis

leing utilized to combat a metabolic acidsis, postoperative carbon dioxide retention vill produce its adverse effects more rapidly.

## RECOGNITION OF POSTOPERATIVE CARBON DIOXIDE RETENTION

recognize postoperative carbon cioxide retention the surgeon must be constantly aware of its possible occurrence. A history of predisposing factors and the finding of bizarre neurological signs should make one suspicious of its presence. Any patient whose breathing is excessively shallow or slow should be suspected of suffering from inadequate elimination of carbon dioxide. If the patient is not receiving an additional supply of oxygen, his inadequate ventilation will also produce hypoxia. If the arterial oxygen content falls below 80%-85%, cyanosis may be recognized. However, if oxygen-enriched mixtures are being inhaled, carbon dioxide retention may occur without associated hypoxia. The best method of confirming the diagnosis is to perform an arterial puncture and measure the pH and total carbon dioxide content. From these two values, the arterial carbon dioxide tension can be calculated. Estimation of the carbon dioxide tension of an end respiratory gas sample will also confirm the diagnosis, but equipment to measure alveolar carbon dioxide tension is rarely available when needed.8

If an estimation of total arterial carbon dioxide content cannot be made, then a measurement of the carbon dioxide com-

TABLE II.—THE EFFECTS OF CARBON DIOXIDE ON THE NERVOUS SYSTEM

- Respiratory centre stimulated then depressed
- Paresis, twitches and tremors.
- Headache

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- 4. Increased cerebral blood flow
- Increased intracranial pressure
- 6. Papillædema

bining power will be of value. As explained previously, however, this value will not be elevated unless the retention of carbon dioxide has been present for from 12 to 18 hours.2 A practical method of diagnosing this condition in the absence of adequate laboratory facilities, is to suspect its presence from the characteristic symptoms and signs and to institute treatment as a therapeutic test.

## TREATMENT

Treatment of carbon dioxide retention consists in providing adequate pulmonary ventilation. In the acute case, such as may be seen in the recovery room, treatment is usually required only for a short time. Assurance of an adequate airway by positioning the patient and providing naso-tracheal suction, avoidance of further sedation, administration of broncho-dilating agents if indicated, and assistance to ventilation by encouragement or manual assistance may be all that is required.

Any obstruction of the airway which is not quickly relieved by conservative measures should be treated by bronchoscopy, intubation, or tracheotomy. Oxygen should be given because hypoxia, by increasing the production of lactic and pyruvic acids, will increase the acidotic tendency. The danger of passively administering oxygen is that of further reducing the pulmonary ventilation of a patient whose respiratory centre has been narcotized by prolonged exposure to high arterial carbon dioxide content and whose respiratory drive is dependent upon hypoxic reflexes.

Intermittent positive pressure ventilators have now become the mainstay of treatment in the serious case of inadequate carbon dioxide elimination. They provide a method of administering oxygen without the danger of diminishing pulmonary ventilation. As the face masks are often uncomfortable, inhibit coughing and suctioning, and predispose to gaseous dilatation of the stomach, a tracheotomy should be performed in any serious case. The tracheotomy tube should be of such a type that a ventilating machine can be easily attached and should have an inflatable cuff to occlude the tracheal lumen. Once a patient has commenced treatment with a

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mechanical ventilator, he should continue it until his arterial pH and carbon dioxide tension are normal. The machines may be triggered by the patient's own respiratory movements, or may be set to ventilate automatically. If congestive heart failure is present, a machine offering both positive and negative pressure may be advisable.

## SUMMARY

A case of ruptured abdominal aneurysm with successful excision and grafting is reported in a 66 year old moderately obese man. The patient did well for five days, after which time his condition began to deteriorate. The diagnosis of carbon dioxide narcosis was not made until the 10th day when effective treatment was initiated.

The predisposing factors and the effect of carbon dioxide retention are discussed. Depression of conscious level, respiration and cardiovascular state is not a clear-cut syndrome and is therefore difficult to recognize clinically.

The diagnosis is established by computing arterial carbon dioxide tension from blood estimations of carbon dioxide content and pH. A change in carbon dioxide combining power is a late manifestation.

Unfortunately the former two blood tests are not routinely available in most hospitals. Under such circumstances the treatment which consists of supplying adequate pulmonary ventilation, should be carried out once the condition is suspected.

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#### RÉSUMÉ

Le but de cet article est d'attirer l'attention sur les dangers de la rétention du gaz carbonique par les malades après l'opération. La ventilation pulmonaire insuffisante mène à une accumulation de CO<sup>2</sup> qui provoque une acidose respiratoire et un état de "narcose au CO<sup>2</sup>".

Un cas de ce genre est décrit. Il s'agit d'un malade de 66 ans opéré d'urgence pour rupture d'un anévrysme de l'aorte abdominale, et ayant subi la pose d'une prothèse aortique. Les suites opératoires furent sans histoire dans les quatre premiers jours; cependant la respiration était très superficielle, du fait de l'existence d'une très longue et douloureuse incision de laparotomie. Le cinquième jour, la situation se gâta: des maux de tête et une somnolence s'installèrent; de la cyanose et des périodes d'apnée firent leur apparition. Des épreuves de laboratoire confirmèrent le diagnostic d'acidose respiratoire; à partir du dixième jour, on pratiqua une trachéotomie et l'on installa un ressucitateur en permanence jusqu'au quinzième jour. L'état s'améliora alors de façon spectaculaire et le malade put retourner chez lui une quinzaine de jours plus tard, en excellente condition.

Les auteurs pensent qu'il s'agissait là d'une narcose au CO<sup>2</sup> par hypoventilation pulmonaire; c'est une complication postopératoire fréquente, mais assez rarement reconnue. Le traitement consiste à mettre en œuvre tous les moyens propres à assurer la liberté des voies aérophores (aspiration des mucosités, éventuellement trachéotomie). et à augmenter l'oxygénation (cependant il faut se souvenir que l'oxygène donné seul et de façon passive entraînera une diminution de l'activité respiratoire).

Les effets toxique du CO2 sur le système cardiovasculaire et le système nerveux central sont décri s et discutés.

# CASE REPORTS

## GREASE-GUN INJURY

J. C. OSBORNE, M.D., F.R.C.S.[C], F.A.C.S., North Vancouver

THE HARMFUL effects of the injection of cils into human tissues have been known since the beginning of this century. The alvent of the high pressure grease gun, row standard equipment in most garages, allows very readily the accidental introduction of lubricating grease into the tissues of a workman using the machine. Such sk is illustrated in the following case 19port.

On May 30, 1957, a 28 year old garage vorker was operating a high pressure grease gun when he accidentally discharged it into the palm of his left hand in the region of the cistal skin creases. The greasing equipment (rade name "Alemite") operated under a pressure of 175 lb./sq. in. Immediate swelling of the palm occurred, and a small pinpoint perforation was visible in the skin. The patient squeezed out some of the grease through this orifice, then reported to his doctor who expressed manually a further small quantity of grease.

Both patient and doctor felt at this point that there was still considerable residual grease in the hand and hot hand soaks containing detergent were prescribed in the hope that further discharge of grease might thus be encouraged—a futile hope as subsequent events indicated. Circulation to the hand and fingers was at no time appreciably compromised.

The hand remained painful and swollen and on June 14 the patient was referred to the author. The entire left palm was diffusely indurated and movement of the fourth and fifth fingers markedly restricted. After three more weeks of expectant treatment, a fluctuant swelling appeared on the medial aspect of the left fourth finger. On July 5 this was incised and about 2 c.c. of clear, grossly unaltered grease was evacuated. The area of entry was also incised at this time but practically no grease could be obtained from this incision.

A week later another swelling appeared on the dorsum of the hand in the web between fourth and fifth fingers. On July 14 a further few cubic centimetres of grease were evacuated from an incision in this area.

The palm was still markedly indurated and finger movement seriously restricted but it was evident that the remaining grease was now so widely disseminated in the tissues of

the hand that any further attempts at removal at this time were likely to be unsuccessful. Accordingly, a programme of watchful waiting was instituted.

Six months later a collection of five nodules had appeared in the hand and on December 5 these were removed, using a tourniquet and general anæsthesia. The nodules were found to consist of small granulomas ("oleomas")<sup>3</sup> lying in the subcutaneous tissues and palmar fascia. At the conclusion of the dissection the digital nerves and vessels and flexor tendons to fourth and fifth digits were exposed in the depth of the wounds.

The hand was much improved but still not normal and on March 17, 1958, a further series of five oleomas was removed. The pathologist reported that the excised tissue consisted in the gross of fibrous nodules containing thick yellow material identifiable as grease in some areas. Microscopically the picture was that of a chronic granulomatous inflammation of the foreign-body type, with cyst-like spaces surrounded by granulation tissue containing epithelioid cells, macrophages, foreign body giant cells, and proliferating connective tissue elements.

Following this last procedure the appearance and mobility of the hand and fingers were improved to a state approaching normal and the patient was fit for return to full work in May. All in all he had been off work for 11 months and had undergone four surgical procedures during that time. The function and appearance of the hand continued to improve over the next several months and are now normal to all intents and purposes.

## DISCUSSION

Reports of similar cases have appeared in the literature over the past two decades, <sup>1-5</sup> although few in recent years. The grease being discharged as it is through a pinpoint orifice under very high pressure, is apparently able to penetrate readily the intact skin, and in so doing leaves only a small wound of entry which may be almost invisible. The foreign material then spreads widely through the tissues and may endanger circulation of the part if tissues become too tense.

Two stages may be recognized in the subsequent course. The early stage consists

of swelling and pain, grease in the tissues in unaltered form, pressure necrosis and possibly gangrene, and the formation of "abscesses" consisting chiefly of grease. The later phase is characterized by the appearance of "grease oleomas"; and if the deposits are extensive, widespread structural and nutritional changes in skin and subcutaneous tissues, with thickening, ulcerations and infections.

## TREATMENT

The best treatment is of course prevention, and garage owners and their employees should be made cognizant of the potential dangers of grease-gun injury and the very serious and disabling sequence of events which can evolve as the result of careless use of this equipment. Workmen's Compensation Boards would be well advised to examine the existing situation with regard to prophylaxis.

Opinions have varied in the past as to the treatment of the acute phase of the lesion. Byrne4 advocated a conservative approach initially in view of the widely disseminated nature of the offending material and the likelihood that complete removal will often prove impossible. Brooke et al.,2 Mason,3 and Bunnell,6 however, all advocate a more aggressive attack, with as early and complete removal of the grease as is possible. The author's experience in this case prompts him to agree with this latter view. The essential thing is to get the foreign material out of the tissues, and this can only be done by operation. The probability that complete removal may not be feasible at an operation done immediately after the injury should not be allowed to deter anybody from doing his best to remove all possible grease at this time and thus diminish the production of reactive changes in the tissues and the necessity for

further operative procedures.

The proper handling of grease-gun injury should therefore consist of immediate evacuation from the tissues of all possible grease by way of generous and strategically placed incisions, using general anæsthesia and a tourniquet under proper operating room conditions. The surgeon should then follow up the case closely with repeated examinations and operations as necessary

to remove oleomas if and when they appear,

#### SUMMARY

A case of grease-gun injury to the har 1 is reported. The potentialities of this injury towards severe and prolonged disability and economic loss are pointed out and a program of treatment is outlined.

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## RÉSUMÉ

Les effets nocifs de l'injection d'huile dans les tissus humains sont bien connus depuis le début de ce siècle. L'apparition des pistolets à graisse à haute pression, qui sont un accessoire indispensable dans l'équipement de garage a entraîné nombre d'accidents de ce genre. Un de ces cas est décrit ici.

Il s'agit d'un employé de garage âgé de 28 aus, qui reçut accidentellement une décharge de pistolet à graisse dans la paume de la main gauche; une enflure considérable de toute la main s'installa immédiatement; il consulta un médecin, qui exprima par compression une petite quantité de graisse à travers l'orifice d'entrée. Des bains chauds avec du détergent furent essayés sans succès et ce n'est que quinze jours plus tard que le malade fut adressé à l'hôpital. La main était toujours considérablement enflée; les mouvements des quatrième et cinquième doigts, très limités. Une incision permit d'évacuer environ 2 c.c. de graisse non altérée. Ultérieurement on dut procéder à plusieurs autres incisions en des points différents pour permettre l'issue de la graisse, soit libre, soit englobée dans des nodules de réaction du type "oléomes". L'ensemble du traitement s'étala s'ir environ un an, jusqu'à ce que finalement les fon tions normales soient totalement restaurées.

Plusieurs cas du même genre ont été rapport s dans la littérature. Il est certain que ces pistole s, qui éjectent de la graisse industrielle sous tr s forte pression à travers un orifice de la taille d'n trou d'épingle, peuvent être responsables de grav s accidents de travail entrainant des incapacit s parfois très longues. Le meilleur des traitemer s est évidement prophylactique: il faut attir r l'attention des employés de garage sur ce nouve u danger. En cas d'accident le traitement repo e sur l'évacuation de la matière introduite.

## TRANS-PYLORIC PROLAPSE OF ABERRANT PANCREATIC TISSUE

J. D. LONGLEY, M.D. and R. W. BOYD, M.D., Vancouver

This is a report of a case of aberrant pancreatic tissue prolapsing through the pyloric canal. Although there have been nany reports of trans-pyloric prolapse of gastric mucosa<sup>5, 7, 9-11, 13</sup> in only two of tiese<sup>3, 4</sup> has the prolapse been of pancreatic tissue.

#### CASE REPORT

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A 59 year old Japanese woman was admitted to hospital nauseated and in severe dehydration. She had pain in her right upper quadrant, nore severe in the late afternoon, for as long as she could remember. This pain bore no relationship to meals. In addition she suffered from anorexia and occasional nausea but not from yomiting.

On examination the patient was dehydrated, pale and showed evidence of loss of weight. Her hæmoglobin was 9.3 g. % and her weight

The patient was treated with various diets and antispasmodics without relief of her pain. Barium meal examination revealed a deformed duodenal bulb. The typical mushrooming



Fig. 1.—Antero-posterior view of the abdomen showing irregular filling defect in the duodenum.



Fig. 2.—Antero-posterior view showing "mush-rooming" into the duodenum.

characteristic of gastric mucosa prolapsing through the pyloric canal was demonstrated. The fact that this was prolapsed pancreatic tissue was not suspected.

There was no delay in the emptying of the stomach (Figs. 1 and 2).

Because there was no appreciable response to medical therapy including diet, antispasmodics and antacids, a laparotomy and partial gastrectomy were performed. At operation scarring of the duodenal bulb was seen and this was judged to be due to a previous ulcer. There was also a cyst measuring 1 x 2 x 2 cm. within the submucosa of the stomach close to the pyloric ring (Fig. 3). This cyst contained clear fluid and was lined with columnar epithelium. On microscopic section pancreatic tissue was found surrounding the cyst. There were acini but no islets (Fig. 4).

## DISCUSSION

The first case of prolapsing aberrant pancreatic tissue was reported by Collett<sup>4</sup> in 1946. He described this condition in a six year old boy with a three year history of intermittent umbilical pain and episodic attacks of nausea and vomiting which were relieved by assuming the genupectoral position. Physical examination was unremarkable except for moderate obesity. Roentgenologic study revealed a small gastric polypoid mass in the prepyloric region, a position permitting prolapse through the pylorus into the duodenum. At operation a small polypoid lesion was found in the pyloric antrum. It was 1.5 cm.



Fig. 3.—Pyloric region of gross specimen showing redundant gastric mucosa which has prolapsed through the pyloric ring, in the central portion of the photograph. Forceps are in the cyst of pancreatic tissue.

in diameter and contained pancreatic tissue. Ducts and acini were present but no islet cells.

In 1957 Bernard<sup>3</sup> reported another case of a 48 year old man with continuous epigastric pain not relieved by food, and nausea without vomiting. Fluoroscopy revealed trans-pyloric mucosal prolapse. Failure of medical treatment resulted in a laparotomy and partial gastrectomy. A

nodule about the size of a large pea corsisting of acini and ducts but no islet cell, was found under the mucosa near the pylorus. The patient was asymptomate after operation.

According to Anderson, the incidence of pancreatic heterotopes in autopsy series is between 0.5 and 5.6%. This is a considerably lower incidence than that reported by Feldman and Weinberg who state that autopsy, in 13.7% of cases, the dudenum contains aberrant pancreatic tissue, and that in 80% of these, the heterotopes are within 2 cm. of the ampulla of Vates.

Pearson<sup>8</sup> gives the incidence as 1% to 2%, whereas Barbosa<sup>2</sup> states that aberrant pancreatic tissue will be found once in every 500 operations.

Histologically the appearance is usually that of normal pancreatic tissue, namely ducts, acini and islet cells, according to Anderson. On the other hand, Robbins tates that islets of Langerhans are often absent. In our own case and those of Collett and Bernard, islet cells were not demonstrated.

No clinical picture is typical of this syndrome, according to Pendergrass. 10 Two of the cases reviewed included intermittent

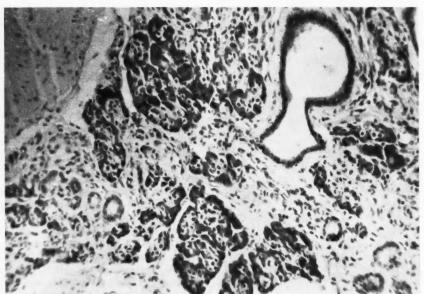


Fig. 4.—Microscopic section showing the acini cell typical of pancreatic tissue (X 100). Note the tendency to cyst formation.

cr impy abdominal pain which could have been due to partial intermittent obstruction of the pyloric canal by the polyp.

#### SUMMARY

A case of transpyloric prolapse of aberrant pancreatic tissue has been presented to gether with a review of two similar cases. This syndrome would seem to be char-

ac erized by vague epigastric pain and na usea, failure to respond to medical manas ement, demonstration of the prolapse at fli oroscopy and complete relief of sympto ns after operation.

#### ACKNOWLEDGMENTS

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Our thanks are due to Dr. L. W. Warcup and D. A. M. Johnson for permission to report this ca e. The authors also wish to thank Dr. P. S. Vassar for the pathological specimens.

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## RÉSUMÉ

Un cas est décrit dans lequel du tissu pancréatique aberrant fait hernie dans le canal pylorique.

Il s'agit d'une femme de 59 ans, de race japonaise, admise à l'hôpital pour des nausées et des douleurs dans le quadrant supérieur droit de l'abdomen. La patiente est déhydratée, pâle et amaigrie. Un examen radiologique montre une déformation du bulbe duodénal avec une image en champignon, caractéristique de la hernie de la muqueuse gastrique dans le canal pylorique; à ce moment on ne soupçonna nullement qu'il s'agissait en réalité de tissu pancréatique.

On pratiqua une laparotomie et une gastrectomie partielle: le bulbe duodénal était porteur d'une ancienne cicatrice probablement due à un ulcère; une formation kystique de 1 x 2 x 2 cm. se trouvait dans la sous-muqueuse gastrique tout près de l'anneau pylorique. A l'examen anatomo-patho-logique on découvrit du tissu pancréatique glandulaire, sans ilôts. Les suites opératoires furent très bonnes.

Une brève revue de la littérature est ensuite donnée.

STUDIES ON VERTEBRATE NEUROGENESIS. S. Ramon y Cajal, Faculty of Medicine, University of Madrid. Translated by Lloyd Guth, M.D., Department of Health, Education and Welfare, Bethesda, Md. 432 pp. Illust, Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1960, \$14.75.

Dr. Lloyd Guth of the National Institute of Neurological Diseases, Bethesda, Maryland, has succeeded in translating into current scientific English, this book of the leading scientist in the field of neurohistology. Published in French in 1929, it has become a classic in the field of vertebrate neurogenesis. Studies in neuronal histogenesis in the spinal cord, cerebellum, cerebral cortex, retina, and in the peripheral nervous system are the main topics of this book. A great number of clear illustrations are helpful in rendering the difficult and partly controversial issues understandable. Dr. Guth has added an author and subject index missing in the French edition. This book will be valuable for English speaking clinical scientists interested in the field of neuroembryology.

## MESENTERIC LIPOMA IN CHILDREN

W. L. OGILVY, M.B., Ch.B., M.Sc., F.R.C.S.[C]° and H. F. OWEN, M.D., C.M., F.R.C.S.[C],† Montreal

ALTHOUGH cystic tumours of the mesentery are seen from time to time in children, solid tumours are exceedingly rare. A child with a large lipoma of the gastro-colic omentum was treated at the Montreal Children's Hospital in November 1958. It is our belief that this will furnish the fifth reported case of mesenteric lipoma in a child, and the first reported in this location.

## CASE HISTORY

A three year old girl was taken to see her family doctor because of loss of appetite. On physical examination a mass was found in the

Fig. 1.—Radiograph of the abdomen in the lateral projection showing a translucent mass lying anteriorly within the peritoneal cavity.†

<sup>o</sup>Clinical Fellow in Surgery, †Assistant Surgeonin-Chief, The Montreal Children's Hospital, and the Department of Surgery, McGill University.

†Acknowledgment is made to Dr. Gilles Boulard, Radiologist, St-Eusèbe Hospital, Joliette, P.Q. for the original film. abdomen and investigation was initiated by having an intravenous pyelogram and barit in series carried out. A diagnosis of intra-abdominal lipoma was established and she was admitted to the Montreal Children's Hospi al on November 9, 1958.

The patient was a bright, well develop d child. The only significant findings on full physical examination were in the abdomen, which was slightly protuberant, and a large smooth, freely mobile non tender mass was palpable. This mass extended from under the left costal margin downwards and to the right to just below the level of the umbilicus.

A review of the previous radiographs showed a normal urinary tract and no intrinsic abnormality of the intestinal tract, except displacement by the mass (Fig. 1). Plain films of the abdomen were taken in the supine and lateral projections and these showed the mass lying anteriorly in the abdominal cavity displacing the gas-filled bowel posteriorly. The mass was noted to have the same radiological density as fat. On this evidence a preoperative diagnosis of intra-abdominal lipoma was made.

On November 11, operation was performed and the mass was exposed through a transverse incision in the left upper quadrant. It was found to be lying between the leaves of the gastro-colic omentum (Fig. 2). A thin filmy layer of gastro-colic omentum could be readily reflected off both anterior and posterior surfaces. The mass had bulged downwards and forwards so that it was lying anterior to the transverse colon and greater omentum. It was easily mobilized, the only firm attachment being at its upper pole where it was suspended by a vascular pedicle, the vessels originating in the gastro-splenic ligament.

The tumour measured 24 x 15 x 5 cm. and weighed 779 g. (Fig. 3). Multiple sections were examined histologically and showed normal lobulated fatty tissue and a fibrous capsule. There were small fat cysts and tiny foci of fat necrosis associated with granulomatous inflammation.

The child's course was quite unevential following operation and she was discharged from hospital on the seventh postoperative day. Subsequent follow-up has shown that her growth development since operation has been normal.

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#### DISCUSSION

The diagnosis of an intra-abdominal from can be made with relative ease by the radiologist. A mass which casts a shadow intermediate in density between air and water is diagnostic of fat. Clinically the picture may vary, presenting, as in this cose with a rather non specific complaint of "hoor appetite" or with crampy abdominal pain, altered bowel habits, varying degrees of intestinal obstruction or merely as progressive enlargement of the abdomen.

The presence of a firm, mobile mass in the abdomen along with the radiological placture described, is all that is required to make the diagnosis. However, the site of origin cannot be determined accurately until laparotomy is performed. The possibility of encountering omental and mesen-



Fig. 2.—Photograph taken during operation showing mass located in the gastro-colic omentum just below the stomach.



Fig. 3.-Specimen removed at operation.

teric cysts should also be considered.

Mesenteric lipomas have been reported in the small bowel mesentery<sup>1, 3, 4</sup> and the transverse mesocolon.<sup>2</sup> A tumour weighing over 8 kg. was found in the transverse mesocolon of an 11 year old boy. To our knowledge the case presented here is the first recorded of a lipoma arising in the gastro-colic omentum.

Simple excision of the tumour is obviously the treatment of choice, but when the lesion is in the small bowel mesentery the blood supply to the bowel may be compromised requiring resection of adjacent small bowel with anastomosis to restore bowel continuity.

#### SUMMARY

Lipoma in the mesenteries is a rare lesion

in childhood. A case report is presented of a lipoma in the gastro-colic omentum. The presenting symptoms are often non specific or there may be varying degrees of bowel obstruction. The radiological picture is typical and allows differentiation from other mobile intra-abdominal masses. Surgical excision is advised.

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## RÉSUMÉ

Les tumeurs kystiques du mésentère sont reltivement fréquentes; par contre, les tumeurs solid s sont particulièrement rares. Cet article rappor l'histoire d'un cas de lipome situé dans l'épiploc a gastro-colique chez un enfant, qui est sans dout le premier du genre à être décrit dans la littér.

Une petite fille de trois ans fut amenée en consultation chez le médecin pour une perte d'ajétit; à l'examen physique une masse fut décorverte dans la région abdominale et l'enfant fut hospitalisée. L'état général était satisfaisant; ventre était légèrement ballonné, et l'on pouvait yealper une tuméfaction de grande taille, mobil, non fluctuante. Les radiographies (pyélographie, lavement baryté) ne montrèrent rien d'anormal; la tumeur était cependant visible sur les radiographies à vide. L'opération fut décidée et à l'ouverture de l'abdomen, ou trouva une tumeur située entre les deux feuillets du grand épiploon, vascularisée à partir des vaisseaux gastro-spléniques. Cette tumeur fut facile à mobiliser et à extirper; elle mesurait 24 x 15 x 5 cm. et pesait 779 g. A l'histologie il s'agissait d'un lipome. Les suites opératoires furent sans histoire.

RADIATION BIOLOGY. Proceedings of the Second Australasian Conference on Radiation Biology held at the University of Melbourne, December 15-18, 1958 by the Australian Radiation Society. Edited by J. H. Martin. 304 pp. Illust. Butterworths Scientific Publications, London; Butterworth & Co. (Canada) Ltd., Toronto, 1959, \$11.00.

It is impressing to see, in a country smaller than Canada such a fine collection of papers on this field presented by such a distinguished group of workers. Papers are included, not only from Australians, but from well known American and British investigators. The non specialist may find some of the material rather abstruse but he cannot fail to be impressed with the lucidity and simplicity of Professor L. H. Gray's chapters on mechanisms of radiation dose, oxygen effects and on recent studies of radiobiological effects at the cellular level. These chapters are worth reading to anyone interested in finding out about radiation biology.

Dr. Loutit has some fundamental material on metabolism of Strontium 90, radioactivity in food and on radiation and leukæmia. Dr. Martin has some further data on radiation dose during diagnostic radiographic procedures in extension of his excellent studies on gonadal dose. There are other papers on radiation effects on solids and solutions, on grafted tissues and on blood cells.

tissues and on blood cells.
Since these chapters are tr

Since these chapters are transcripts of papers presented at the session they are not broken down or subdivided as would be done if prepared for a book. Also the slides presented with the papers are missing. A short summary and conclusion at the end of each would have helped a great deal.

One cannot conclude a review of this book without commending the exceedingly fine foreword by Sir MacFarlane Burnet which places radiation hazards in normal use in their proper perspective. It should be read by anyone who has anything to do with the use of radiation.

KLINISCHE CHIRURGIE für die Praxis. In vier Bänden. Band 1. Lieferung (Clinical Practice of Surgery. In 4 volumes, Vol. I Part I). Edited by O. Diebold, H. Junghanns and L. Zukschwerdt. 184 pp. Illust. Georg Thieme Verlag, Stuttgart, W. Germany; Intercontinental Medical Book Corporation, New York, 1959, \$8.60.

This publication is not intended just to become another surgical textbook for undergraduates or to present the technical part of surgery. It is planned to bring the clinical aspects into focus by presenting pathogenesis, diagnosis, differential diagnosis, indications, the possible methods of treatment and preoperative and postoperative care, in the meantime recognizing pathological and physiological progress in the last few decades.

The first part of the present section deal with wounds, their types, healing, infection and parasitic diseases. The second part discusses thermal and electrical burns, and metabolic and chemical changes in them, with their

local and systemic effects.

# SURGICAL TECHNIQUE

## FURTHER STUDIES OF CATHETER-VENOSETS EMPLOYING HALF-NEEDLE GUIDE\*

ERIC C. ELLIOT, M.D., B.Sc. (Med.),† Edmonton, Alta.

It is possible to insert a catheter into a siperficial vein semi-automatically by means of a half-needle guide (Fig. 1). Ifter the vein is punctured, the guide can be withdrawn while simultaneously advancing the catheter into the vein; this combined manœuvre automatically disengages the catheter from the needle. The insertion of a catheter already attached to a venoset and filled with fluid becomes a simple procedure.

In a preliminary communication,<sup>1</sup> the initial 100 trials with the catheter-venosets (especially with catheter size PE-50) utilizing earlier versions of the guide, indicated that a low failure rate might be possible with this method. A further 108 administrations using a later model of the guide have substantiated this view; these results are now reported.

#### METHODS

The usual procedure of applying a tourniquet and disinfecting the skin was carried out, occasionally shaving the hair. The catheter set was connected to the venoset and the lines filled with fluid from the infusion bottle. The skin and vein were punctured by keeping the bevel side of the half-needle point uppermost. A jet of blood usually appeared in the catheter, visible in the half-needle when the vein was entered. The tourniquet was released, the rate clamp opened to check entry of the vein, and then the catheter was advanced and the guide removed.

The intravenous tubing was looped in a U shape and taped to the skin with two strips of Elastoplast.<sup>1</sup> If the catheter was located (a) in the antecubital vein, a flannel bandage about the wrist was used to restrict motion at the elbow from 5° to 10°; (b) if on the back of the hand, a

small wrist splint was employed; (c) if in the forearm no splinting was necessary.

The words "CATHETER - IN" were printed on the tapes to indicate to the nurse responsible for discontinuing the infusion, that a catheter was being used.

## RESULTS AND DISCUSSION

Catheter-venosets were employed on patients picked at random from surgical wards; most of them were men. In 50 cases size PE-50‡ catheters were used; these were introduced through half-needles constructed from 18 gauge thin-wall needles. In 49 of these cases the doctor's order for the 24-hour period, consisting usually of 1-2.5 l. of intravenous solution, was carried out successfully. The only failure occurred in the first patient in the series, who was very obstreperous and pulled the venoset tubing apart where it was connected to the rubber injection tubing.

Catheters of size PE-10 were employed in 58 other patients. These tubes fitted into half-needles made from ordinary 19 gauge needles. In 13 cases the transfusion stopped running. The only explanation for this seemed that either the bore of the catheters was too small or the fine flexible tubing had become kinked.

All these transfusions lasted only a few hours, except one which was continued for about 48 hours. In view of phlebitis² that often results from prolonged intravenous transfusions, it was concluded that this should be a separate investigation. It was observed that the 3 in. catheter (Fig. ID) had a "governor effect" upon the rate of administration of the fluid. With the clamp wide open it took four and one-half to five hours for two litres of 5% solution to run in.

Certain technical features of the guide are worth stressing. The half-needle in no

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of Alberta, Edmonton.
†Fellow of the National Heart Foundation. Work
on this project was also carried out during the
tenure of a Canadian Life Insurance Fellowship.

<sup>‡</sup>PE stands for polyethylene, and the number indicates the size of the tubing; both are a connotation of Clay Adams, the manufacturer.

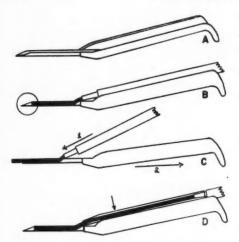


Fig. 1.—Four views of guide and catheter set are presented. The handle of the guide was made from hard polyethylene (Marlex 50‡), into which the half-needle was embedded. The guides, with catheter sets positioned in the half-needles were packaged individually in plastic bags and sterilized with ethylene oxide (Steroxcide 12§).

A.-Oblique view demonstrating the slot in halfneedle and the angle between the needle and handle. The angle allowed advancing and withdrawing the needle parallel to the vein axis. The small hook at the distal end of the handle facilitated withdrawal of the guide. B.-Side view of the guide with short 1 in. catheter in position. The end of the catheter passed only to the base of the bevel of the needle. The constricting action of the needle, as well as grasping the handle and tubing between thumb and forefingers, maintained the catheter in position during the venipuncture. It is necessary to introduce the needle point (see circle) into the vein just far enough to ensure that the catheter when advanced, passes into the lumen and not interstitially. C.-Catheter being advanced or skidded along open part of needle by forcing the catheter-adapter forward and downward in the direction of arrow-1, and withdrawing the guide in the direction of arrow-2. D .- Side view showing longer 3 in. catheter. Cover (arrow) keeps the flexible polyethylene catheter sterile, and prevents buckling; the cover is split along one side. After the catheter is introduced into the vein and the guide disengaged, the proximal 2 in. of catheter is advanced along the split in the cover, which is then discarded. The 3 in. catheter is recommended for use in a vein near or over a joint such as the elbow.

‡Marlex 50: A product of Phillips Chemical Company, Plastics Sales Division, Bartlesville, Oklahoma.

§Steroxcide 12: Trademark for gas mixture of ethylene oxide and inert gas. Former is the sterilizing agent and latter is present to make gas mixture non-inflammable. Produced by Wilmot Castle Company, Rochester, N.Y. instance severed the catheter because it the construction of the half-needle from whole needle the base of the bevelled point, which can act as a shearing edge was filed away. Further, since the half-needle was actually slightly more that half a needle it exerted a slight constriction on the catheter. This was necessar in order to keep the catheter in the needle. The constriction was overcome by the disengaging process (Fig. 1C). This maneuvre because of the edges of the half-needle, caused a slight marking of the catheter but it was never of any consequence.

Although blood or fluid of similar viscosity would run through the PE-50 catheter a larger bore catheter would be required if it were necessary to pump blood into the vein. The application of the catheter-venoset in pædiatrics was not investigated owing to the unavailability of small gauge thin-wall needles and fine, stiff plastic tubing.

#### CONCLUSIONS

Catheter-venosets (especially with the PE-50 catheters), judging from the results to date could be of practical value because the failure rate of 2% is low and the method is simple. The needle being open along one side prevents the cutting of the catheter in two.

#### ACKNOWLEDGMENTS

The author is grateful to the nurses, house staff, doctors, authorities of the University of Alberta Hospital, Edmonton, for their co-operation; to Mr. R. MacDonald and staff of the University machine shop; to the Plastics Division of Phillips Chemical Company, Bartlesville, Oklahoma, for the Marlex 50; to Mr. J. Clark of Canadian Industries Limited, who offered information on how to obtain hard polyethylene, and to Cutter Laboratories, Berkeley, California, for certain component of the sets.

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#### RÉSUMÉ

Il est possible d'insérer un cathéter dans une veine à l'aide d'un guide formé d'une moitié d'aiguille: après avoir ponctionné la veine, ce onducteur peut être retiré doucement cependant cue l'on engage progressivement le cathéter dans l vaisseau.

La technique utilisée est décrite en détail, de même que l'appareillage employé.

La méthode a été essaye sur une centaine de patients, pris au hasard en salle d'opération, dont la plupart étaient des hommes. Les transfusions passèrent fort bien avec les cathéters N° 50; il y eut quelques difficultés avec les N° 10.

## DISINFECTION OF ANÆSTHETIC APPARATUS

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ATTENTION IS occasionally turned on næsthetists' equipment as a vehicle for l acteria responsible for infections occurring in hospital. Since 1933 there have been at least twelve publications dealing with the subject; these represent a very small proportion of the total amount written on hospital infection as a whole. Although some papers have suggested that it is possible that anæsthetic apparatus has been or could be the vehicle of bacteria or viruses causing infections, it has never, in fact, been demonstrated that such infections have been caused by anæsthetic apparatus. Although pathogenic organisms have been found on anæsthetic apparatus, it has never been shown that it was contaminated to a greater degree than its environment including the patient himself or the air he breathes.

One of the earliest references to the possibility of the transfer of infection by anæsthetic apparatus appears in "Queries and Minor Notes" where a practitioner enquires about the possibility of transmission of influenza by this method. In the following year Magath¹² describes some experiments on anæsthetic apparatus to show that transmission of bacteria is possible. He introduced a water trap into the apparatus for the purpose of diminishing the passage of bacteria. Also he suggested the use of soap and water to wash the apparatus.

There are few or no references to the cleaning of anæsthetic apparatus in standard textbooks on disinfection and steriliza-

tion or those on surgical technique or those on anæsthesiology. From time to time, however, it is referred to in medical literature. In "Queries and Minor Notes"15 an expert states that manufacturers recommended soap suds and hot water for cleaning and that metal parts may be autoclaved and rubber parts boiled. He also mentions the use of mercury bichloride, saponated solution of cresol (Lysol), alcohol and formaldehyde. The use of a cresolic disinfectant has been shown to produce burns owing to its solubility in rubber7 and for this reason is not in fact widely used. The anonymous expert also stated that the sodalime canister could be autoclaved and that it did not allow the passage of organisms. This latter statement is confirmed by the experiments of Adriani and Rovenstine<sup>1</sup> who showed that nebulized suspensions of E. coli and tubercle bacilli could not be detected as passing through a canister. Also tests were carried out with canisters used on patients known to have tubercle bacilli in the sputum. From their results they concluded that the soda lime canister was not important in the transfer of infection.

Livingstone and his colleagues<sup>9</sup> developed a formalin-alcohol mixture that disinfected masks contaminated with tuberculous sputum. It was apparently necessary to wash the masks thoroughly after soaking in their mixture to avoid burning subsequent patients and this solution does not seem to have been widely used.

In 1952 Joseph<sup>8</sup> demonstrated large numbers of organisms in breathing tubes and bags and showed that they could be substantially reduced by simple rinsing. An even greater reduction was obtained from

<sup>&</sup>lt;sup>o</sup>From the Departments of Bacteriology, Winnipeg General Hospital and the Medical School, University of Manitoba, Winnipeg.

the use of "pHisoderm" containing 3% hexachlorophene. The British Medical Journal³ commenting on Joseph's paper, indicated that the boiling of parts of anæsthetic apparatus was common in Britain and that face masks could be soaked in 1:2000 biniodide of mercury. Smith²o suggested that careful cleaning and disinfection of endotracheal tubes was necessary for the prevention of tracheitis in children.

Gross<sup>5</sup> investigated the use of Zephiran (benzalkonium chloride) for the disinfection of anæsthetic apparatus following soap water washing. Using Zephiran (1:1000) he was able to disinfect all but a third of breathing tubes and bags. The prominent organisms were gram-negative bacilli including Ps. pyocyanea which, Gross<sup>5</sup> stated, was demonstrated to "grow" in the Zephiran and was present in the Zephiran reservoir in the hospital. This is particularly significant in the face of a report<sup>14</sup> that Zephiran contaminated with Ps. pyocyanea was responsible for 40 instances of bacteræmia and at least one death.

McDonald, Welch and Keet<sup>11</sup> investigated pHisohex, i.e. pHisoderm (consisting of sulphonated ether petroleum, lactic acid, wool fat and cholesterols) together with 3% hexachlorophene - for cleaning endotracheal tubes. They showed that scrubbing with a brush for about one minute (40 to 100 strokes) was sufficient to sterilize them whereas two bar soaps (Dial and Gamophen) containing 2% hexachlorophene were not effective. They did not test the antituberculous activities in practise but quoted Florestano4 who had shown that hexachlorophene was one of the most active bisphenols against tubercle bacilli. It was found to be inhibitory at a concentration of 0.24 mg. %.

Ziegler and Jacoby<sup>21</sup> studied the effects of several disinfectants on fine rubber simulating the balloon of inflatable endotracheal tubes including two concentrations of alcohol, "detergicide" and 1:1000 Zephiran. They found that, if the rubber were contaminated with sputum and washed with pHisoderm while still moist and soaked in the solutions, all solutions were effective except detergicide. When the sputum was allowed to dry, however, only boiling for 15

minutes was effective. These authors enphasized that it was imperative to prevent drying of secretions and recommended the use of 70% alcohol. Hexachlorophene was not investigated.

Smith and Howland<sup>19</sup> were able of sterilize 18 out of 41 (44%) endotrached tubes with 0.6% to 0.8% hexachlorophened. When using 3% hexachlorophene they claimed an improvement, obtaining 12 (75%) sterile endotracheal tubes out of a total of 16 satisfactorily tested. Although their results are not statistically significant they agree with McDonald et al.<sup>11</sup>

Nimeck and his colleagues<sup>13</sup> describe the techniques used in the University of Alberta Hospital where masks are not routinely decontaminated but washed only occasionally with "Germa Medica" soap which contains 2% hexachlorophene. Endotracheal tubes are first washed in Germa Medica or pHisohex and then soaked in 1:1000 Zephiran solution. Using a slightly different technique from ours they found all of them contaminated and many with staphylococci and potentially pathogenic gramnegative organisms including Ps. pyocyanea. They considered their findings sufficient indication for changing their methods but did not recommend any alternative.

Finally, a recent report from Britain¹¹¹ concludes that boiling water or autoclaving should be used for the sterilization of anæsthetic apparatus. If the rubber is considered delicate then soaking and rinsing in water at 60° to 70° C. (hotter than the hand can stand) is recommended. Although this method was not guaranteed to inactivate all pathogens it was stated that it would reduce them to a small number. These conclusions were based on experiments with bacteria and viruses.

Although it seems that anæsthetic apparatus is not a potent source of infectior, it was thought worthwhile to try out some simple method of bacteriological sampling of the apparatus in present use at this hospital. This was done firstly to see what kind of results we might expect from apparatus cleaned by recognized methods, during aperiod when the average number of infections per month occurring in the hospital was reasonably steady and was not high. Using such figures we could see if the

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standard of cleaning was maintained and also would be ready to compare new methods of cleaning with those in present use.

This paper contains the results of applying such simple methods.

## MATERIALS AND METHODS

All tests were carried out on clean equipment ready for use in the operating rooms between May and December 1959.

The operating room floor where the nachines were situated had been newly built and elaborate precautions had been istituted to maintain sterility in them. The nachines were stored ordinarily in the non-serile area until required for use when they were wheeled into the sterile area.

We visited the operating room in the fternoons after operations had ceased. Such machines as had been cleaned were sampled. Each time an attempt was made to sample those machines that had not previously been tested. In this way 14 machines were sampled once, five were tested twice and two were tested on three occasions. On six occasions breathing bags were tested alone-the remainder of the time, bags and apparatus were tested at the same time. On four occasions breathing bags had been left on the machine as they had been used with non rebreathing valves and had not been cleaned. The results obtained from these were similar to the others and so are not considered separately. Thus, the total number of occasions on which machines were tested was 23.

A note was made of the time that had elapsed between cleaning and sampling and of the date on which sampling took place. Neither of these affected the results and so are not considered further.

## CLEANING OF ANÆSTHETIC APPARATUS

All pieces of apparatus were first rinsed in hot water, then Germa Medica liquid soap (0.2% hexachlorophene in soap) was poured all over them and rubbed by hand. Then the pieces of apparatus were rinsed in hot water until the rinsing water was quite clear.

After this procedure the pieces of apparatus were allowed to drain and dry by themselves. The endotracheal tube, the connecting joint for the endotracheal tube, and airway were then soaked in 1:1000 Zephiran (benzalkonium chloride). Any piece of apparatus other than the ones listed which became unusually covered with secretions or which had been used with a heavily infected patient was also soaked in Zephiran for half an hour.

After cleaning, masks, breathing tubes, breathing bags, and Y-connectors were assembled and left in place on the machine. Endotracheal tubes, airways and suction catheters were either covered with gauze or latterly placed in a plastic bag on top of the machine. The plastic bag was not cleaned. Laryngoscopes were in addition wiped with a cloth soaked in ether and then placed in leather bags, which were not cleaned, and put in the drawer of the apparatus. The connecting joint for the endotracheal tube was kept in the drawer of the anæsthetic machine.

## SAMPLING METHOD

(a) Swabs. — Commercially prepared (Curity or Johnson & Johnson) swabs were marked on one side of the applicator stick so that they could be rolled one complete revolution on a surface. It was found that swabs could be made to come into contact with an area from about 1.2 cm. to about 3.3 cm. in length by about 1.0 cm. in width. On the whole, Curity swabs were larger and more consistent than those of Johnson & Johnson. However, this variability did not turn out to be a critical factor in our investigation.

The swabs were sterilized and were rolled (without moistening) one complete revolution on the different pieces of anæsthetic apparatus listed in Tables I, II and III. They were then rolled similarly on a blood agar plate. The plates were incubated overnight at 37° C. and the number of colonies counted. If the colonies were so confluent as to be uncountable an estimate was made of the number present.

After the swabs had been rolled on the blood agar plates they were cut off so that the cotton wool end fell into thioglycollate broth. The broths were incubated from 44 to 48 hours and then streaked on

TABLE I.—ANÆSTHETIC APPARATUS: RESULTS OF ROLL-SWABS\*

Apparatus tested		Total swabs	Unsterile swabs	Total organisms	Average organisms per swab
Mask rim	Mouth	15	4	6	0.4
	Nose	15	3	10	0.7
Airwayt		14	2	5	0.4
Endotracheal tub	es† No. 1	16	6	11	0.7
	No. 2	16	3	4	0.3
Laryngoscope		17	3	7	0.4
Endotracheal con	nector†	17	3	4	0.2
		9	0	0	0.0
Totals		119	24 (20%	6) 47	0.4

\*Swabs rolled about a horizontal axis first in contact with apparatus being sampled and then in contact with a blood agar plate.  $\dagger$ Soaked in Zephiran.

blood agar plates. These were incubated overnight and organisms were identified by their colonial appearance. Staph, pyogenes was identified by subculturing on phenolphthalein phosphate plates<sup>2</sup> and those gramnegative bacilli fermenting lactose on desoxycholate agar (Difco) plates were described as coliform organisms. Ps. pyocyanea was identified by colonial appearance and the production of characteristic odour and green pigment. Other organisms identified by cultural characteristics and staining were B. subtilis and various cocci other than Staph, pyogenes.

(b) Breathing bags.—Ten millilitres of sterile saline was poured into a breathing bag and thoroughly moved around within it. The fluid was then returned to the sterile bottle. One millilitre of the saline washing was then added to about 10 ml. of warm molten agar, mixed thoroughly and poured into a Petri dish, allowed to solidify and then incubated at 37° C. The remainder of the saline wash was stored in the refrigerator. The following day the number of colonies was counted in the pour-plate. If there were more than ten colonies, serial tenfold dilutions were made from the stored saline wash and pour-plates prepared from

them. In this way an estimate was obtained of the number of organisms in one millilitre. No attempt was made to identify organisms, although it was noticed, on account of the presence of diffusible green pigment, that *Ps. pyocyanea* was present on several occasions.

## RESULTS

The results of the "roll-swabs" are shown in Tables I and II. Table I shows that none of the pieces of apparatus listed (the masks, airways, endotracheal tubes, laryngoscopes, connectors, and catheters) yielded swabs with an uncountable number of organisms and, in fact, 80% of the swabs thus obtained were sterile. On the average there were 0.4 organisms per swab. Table II shows the results with the Y-connectors and the breathing tubes which yielded a relatively larger number of unsterile swabs. The breathing tube seemed to be the most contaminated. Taking both pieces of apparatus together, 64% yielded sterile swabs although over half of those growing organisms vielded uncountable numbers. The estimated average numbers of organisms per swab show a very much higher level than the apparatus listed in Table I.

TABLE II.—ANÆSTHETIC APPARATUS: RESULTS OF ROLL-SWARS

Apparatus tested	Total Unsterile swabs swabs		Swabs with uncountable organisms	Countable organisms	Estimated total organisms	Average organism per swal
Y-connector	17	5	1	18	68	4.0
Breathing tube	16	7	6	4	394	24.6
Totals	33	12 (36%)	7	22	462	14.0

\*Swabs rolled about a horizontal axis first in contact with apparatus being sampled and then in contact with a blood agar plate.

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TABLE III.—ANÆSTHETIC APPARATUS: SWABS CULTURED IN BROTH

				Swabs with			
A paratus		$_{swabs}^{Total}$	Unsterile swabs	Staph. pyogenes	Ps. pyocyanea	Coliforms	Others*
Mask rim	Mouth	14	5	0	0	0	5
	Nose	13	7	1	0	0	6
A rwayt		13	0	0	0	0	0
E dotracheal tubest	No. 1	15	5	0	0	0	5
	No. 2	15	3	0	0	0	3
L ryngoscope		16	7	2	0	0	5
E dotracheal connec	tort	16	3	0	0	0	3
St ction catheter		8	2	0	0	0	2
Y connector		14	4	0	2	1	2
B eathing tube		13	6	0	4	2	3
Total		137	42	3	6	3	34

<sup>\*</sup>B. subtilis and cocci other than Staph. pyogenes. †Soaked in Zephiran.

Table III shows the results of culturing the swabs in broth. Using this method two-thirds of all swabs were sterile. Most unserile swabs yielded miscellaneous organisms of little pathogenic importance and apart from three swabs yielding Staph. pyogenes the only pieces of apparatus with potentially pathogenic organisms, in the shape of Ps. pyocyanea and coliforms, were Y-connectors and breathing tubes.

Table IV shows the results of the tests on the breathing bags—the great variability in the results is to be noted ranging from no organisms to eight million per ml. However, five breathing bags, or 22%, were sterile by our testing method. Twelve breathing bags, more than half of the total, gave a total of 2.7 organisms per ml. or less. Among the larger counts it was noted that on four occasions *Ps. pyocyanea* was associated with the highest—ranging from 5330 per ml. to more than 8 million.

## DISCUSSION

The results we have obtained agree fairly well with those of other workers when different techniques are taken into consideration. The percentage of sterile swabs obtained by us (64%-80%) is of the same order as that obtained by Gross<sup>5</sup> and Smith and Howland<sup>19</sup> but somewhat smaller than that reported by Livingstone *et al.*<sup>9</sup> These last workers, however, were using a formal-dehyde alcohol solution. Our bacterial counts did not exceed 2.7/ml. of washing fluid in half the breathing bags, whereas Joseph<sup>8</sup> records counts of from 100 to 800/ml. Also Ziegler and Jacoby<sup>21</sup> record

counts of 3000 and 24,000 using a different method; however, bacteria are obviously numerous in their investigation. It is of interest to note that, although our results were similar to those of other workers, 0.2% hexachlorophene was used instead of the recommended 3%. The hexachlorophene was used however in conjunction with Zephiran on three pieces of apparatus; most other workers have used either one or the other.

Pieces of equipment giving the highest counts are Y-connectors, breathing tubes and breathing bags. While we have no evi-

TABLE IV.—Anæsthetic Apparatus: Bacterial Counts on Breathing Bags

Anæsthetic machine	Test number	Bacteria per ml. of washing fluid
1	. î <sup>2</sup>	4.8 x 10 <sup>3</sup>
	ii	1.8 x 104
2		0.7
32		8.7 x 106
4		5.6 x 10 <sup>3</sup>
	ii	0.3
5		1.4 x 104
	ii	0.3
	iii	0.0
6		0.0
82		2.5 x 10 <sup>5</sup>
9		5.3 x 10 <sup>3</sup>
	ii	0.0
10		0.3
ii		2.1 x 10
	ii¹	0.0
	iiii	0.8
12		2.1 x 10
14		1.9 x 10
	ii	2.7
15	i	2.2 x 10 <sup>2</sup>
	ii	0.0
16		2.0
16		2.0

<sup>&</sup>lt;sup>1</sup>Non rebreathing valve used. <sup>2</sup>Ps. pyocyanea isolated.

dence that infections are caused by anæsthetic apparatus it would be reassuring to have bacterial counts as small as possible provided that cost of achieving them in time or money is not prohibitive. Mask mounts are entirely of metal and could be treated with heat in the form of boiling or autoclaving quite easily. Breathing bags and breathing tubes are more delicate to handle. Perhaps spare bags and tubes could be used to allow longer contact for antiseptic solutions. Thorough rinsing in cold water, followed by thorough rinsing with a soap or detergent in warm water and then rinsing again in very hot water would be the first stage. This could be followed up by irrigation with a disinfectant solution such as Zephiran 1:1000. Autoclaving or boiling would however be methods of choice for disinfection.

One point is of considerable importance, namely that fresh solutions of Zephiran should be used. The dangers have been pointed out by Plotkin and Austrian<sup>14</sup> who described 40 cases of bacteræmia with at least one death from *Ps. pyocyanea* following the use of materials stored in a cationic surface active agent which apparently allowed the organisms to live or survive in it. *Ps. pyocyanea* is a very resistant organism and has also been found in the lubricating agents used by anæsthetists.

It would be useful here to summarize what appear to be the important points of cleaning anæsthetic apparatus.

(a) Do not allow discharges or exudates from patients to dry on pieces of apparatus.

(b) First rinse with cold water to avoid coagulation of proteins.

(c) Clean well with brushing and an efficient detergent—here it would be better to choose a substance for its detergent action rather than its disinfectant action.

(d) Rinse well with as many changes of as hot water as is possible.

(e) Disinfect in one of the following ways:-

1. Where possible wrap and then autoclave all apparatus. Robertson<sup>18</sup> has advocated that all intratracheal tubes should be autoclaved.

2. If autoclaving is impossible boiling should be substituted but this method does not have the reliability of autoclaving nor can the pieces of apparatus be wrapped under sterile conditions.

3. If the patient on which the apparat is was used was not particularly contaminated and neither sporing organisms nor tubercle bacilli are suspected, and autoclaving or boiling are not possible, treatment with one or more of 1:1000 Zephiran (benzalkoniu in chloride) or 3% hexachlorophene, in sone form or other, or 70% alcohol should be used. The disinfectant treatment should be carried out for an adequate length of time, at least one hour. The antiseptic solutions should always be fresh.

4. If autoclaving or boiling are not possible and the case is "dirty" or tubercle bacilli or sporing organisms are suspected then a formalin-alcohol solution should be used. The apparatus should be thoroughly and carefully rinsed afterwards to avoid the transfer of formalin to a patient's skin.

The ideal method would undoubtedly be to-use only sterile wrapped anæsthetic apparatus—this would require the purchase of extra sets of apparatus so that while some is being sterilized there is some available for use. An objection to this procedure is that the life of rubber anæsthetic equipment is shortened by autoclaving. This objection, however, can be reduced to its proper perspective by comparing the importance of the life of the rubber and the life of the patient.

Although not in general use yet ethylene oxide sterilization of anæsthetic apparatus is feasible. It is, however, very expensive and extremely slow for not only is the sterilization cycle long, but rubber absorbs ethylene oxide and has to be allowed to air for 24 hours before use to avoid the vesicant action of the gas released from rubber.

Some attention should perhaps be given to iodophors for the disinfection of anæsthetic apparatus. These substances are mictures of iodine and surface-active agens and are alleged to kill vegetable organisms, tubercle bacilli, viruses and spore forming organisms. They are reputed to be non irritating to human tissues. They are pae yellow or brown solutions which lose the recolour at the same time as their antibaterial efficacy. A full description of the properties may be found in the text-book by Reddish.

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#### SUMMARY

Bacteriological tests on pieces of anæsthetic equipment were carried out on 23 occasions after the standard method of ceaning presently in use in the Winnipeg

Ceneral Hospital.

One set of tests consisted of estimating tle number of organisms on an area covered by one complete revolution of a standard svab. A total of 152 swabs were examined ir this way. From 60% to 80% of swabs showed no organisms. Mask mounts and breathing tubes were the most heavily contaminated. Three swabs out of 137 (2%) contained Staph. pyogenes. Except for these, if the mask mounts and breathing tibes are excluded, apparatus was contaminated only with non pathogenic bacteria. Nine out of 27 swabs (33%) from mask mounts and breathing tubes were contaminated with gram-negative bacilli, including Ps. pyocyanea.

Another set of tests consisted in washing the inside of breathing bags with 10 ml. of saline and then performing bacterial counts on them. Counts ranged from zero to more than 8,000,000 organisms per ml. Over half (12/23) yielded counts of 2.7 organisms per ml. or less. The presence of Ps. pyocyanea was noted on four occasions.

Our results are comparable with reports found in the literature which is reviewed. Certain general recommendations are made concerning the cleaning of anæsthetic apparatus. The possibility of using ethylene oxide sterilization and iodophors is dis-

cussed.

#### ACKNOWLEDGMENTS

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## RÉSUMÉ

L'attention des médecins est attirée sur la possibilité de contamination microbienne par l'équipement anesthésique; une revue de la lit-térature publiée à ce sujet est donnée dans le texte.

Les auteurs décrivent ensuite leurs expériences personnelles. Des pièces d'appareils à anesthésie furent examinées au point de vue bactériologique dans 23 occasions, avant ou après le nettoyage de routine institué dans l'hôpital; ce nettoyage se fait par rinçage dans l'eau chaude, puis lavage dans un savon liquide spécial; les tubes endotrachéaux sont désinfectés au Zéphyran.

Les méthodes de prélèvement bactériologique sont ensuite données; prélèvement par porte-coton stériles, lavage des sacs respiratoires avec 10 ml. de solution physiologique stérile, puis mise en culture. Les résultats sont présentés sous forme de tableaux. Les pièces d'équipement qui montrèrent la plus forte contamination furent: les tubes et les sacs respiratoires et les tubes de connexion en Y.

A la suite de cette étude, un certain nombre le recommandations sont faites; il faut éviter le laisser venir les exsudats en contact avec l'appar il anesthésique, et si cela se produit il faut nettoy rau plus vite; les premiers rinçages doivent être faits à l'eau froide, l'eau chaude coagulant les protéines; nettoyer à la brosse; toutes les fois que cela est possible, passer à l'autoclave. Il deviendra it maintenant possible de stériliser tout l'appar il par l'oxyde d'éthylène ou des substances du gen e "iodophores". Ces méthodes endommagent peu être légèrement les parties de caoutchouc, mais la vie d'une pièce de caoutchouc est bien peu de chose en comparaison de la vie du paties t.

PERIPHERAL FACIAL PALSY, pathology and surgery. Karsten Kettel, Chief Surgeon, Department of Otolaryngology, Frederiksborg Central Hospital, Hillerod, Denmark. With a foreword by Terence Cawthorne, F.R.C.S., England. 341 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959. \$23.50.

This monograph, by the Chief of the Department of Otorhinolaryngology at Frederiksborg, Denmark, centres upon the problem of surgical decompression, suture or grafting of the facial nerve in a variety of conditions of differing etiology but all associated with peripheral facial palsy. It is based on the author's experience over a period of 20 years with a series of 311 patients.

He sets out the aim of his book to establish indications for surgical intervention upon the facial nerve and to present the results obtained by nerve repair, to stress important points from the clinical and surgical aspects in improving the results, and to describe the operative findings in the light of the etiology and pathogenesis of peripheral facial palsy.

The author first reviews the anatomy and physiology of the facial nerve from the literature, with a section on degeneration and regeneration of nerves in which he uses the clinical classification of Seddon. Operative methods are treated in considerable detail and illustrated with a number of color reproductions

The author performed decompression in 136 patients with Bell's palsy and reviews the results based on his personal examination of almost all of the cases. He advocates decompression as an emergency operation if the palsy is accompanied by severe pain, if there are no signs of return of function within two months after the onset, and in cases of incomplete spontaneous recovery, and in relapsing palsy.

Surgical decompression of the nerve in the Fallopian canal is also advocated in Melkersson's syndrome in which facial palsy is accompanied by ædema of the face and sometimes associated with furrowing of the tongue. He no longer advocates decompression of the facial nerve for hemifacial spasm.

There are interesting sections on facial palsy associated with tumours, herpes zoster and as a complication of surgical intervention or after fractures of the petrous bone. The results of decompression are presented for these various conditions. The final chapter reviews the results of nerve grafting and nerve suture in 78 cases. The author reports a clinically satisfactory result in 57 of 63 patients in which grafting of the facial nerve in the canal was performed.

Dr. Kettel discusses frankly some of the uncertainties in the diagnosis and selection of cases for surgical treatment. The role of electromyography and electrical diagnosis is reviewed but the author presents few specific findings from his own cases. The immediate partial improvement in the postoperative period following decompression of the facial nerve is strikingly similar to that seen after decompression of the median nerve in the carpal tunnel or the ulnar nerve in the cubital tunnel. The physiological basis of this rapid recovery after chronic partial palsy remains to be explained.

The book is handsomely published, with a bibliography of 650 references and numerous illustrations of patients before and after sugical procedures on the facial nerve. The reader found only a few typographical error. Partly because of the author's method of partition of the subject there is a certain amount of repetition of material but as Mr. Terence Cawthorne writes in the foreword, "Dr. Kettel has made a great contribution to our knowedge of facial palsy", and the reviewer would agree with him that "his monograph will soon be found on the bookshelf of every one who interested in the subject."

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## EXPERIMENTAL SURGERY

# MORPHOLOGICAL CHANGES IN THE LIVER AND BILIARY TRACT OF DOGS WITH PARTIAL BILIARY OBSTRUCTION°

A. C. RITCHIE, M.B., F. G. MURPHY, M.D., D. R. WEBSTER, M.D. and STANLEY C. SKORYNA, M.D., Monertal

COMPLETE, unrelieved obstruction of the common bile duct leads to severe liver camage, and to death, so that indication for surgical intervention is indisputable. Several writers have described the morphological changes found in the liver and tiliary tract of patients with severe extralepatic biliary obstruction, and have discussed chemical abnormalities noted in the llood.8, 10, 12, 13, 15 There have been many experimental studies of the effect of complete obstruction of the common bile duct on the liver and biliary system of animals. The earlier experimental work is reviewed in detail by Cameron and Oakley,2 and among more recent papers on experimentally induced complete obstruction of the bile duct are those of Koch-Weser et al.6 MacGregor,7 Trams and Symeonidis14 and Cameron, et al.1 Much less attention has been paid to the effects of partial obstruction of the extrahepatic biliary tree, even though partial obstruction is more common than complete, and experimental studies of partial biliary obstruction have been few. Wangensteen et al.4 reported the production of biliary concrements in various animals with an incomplete stricture of the common duct; Jacques and McAdams<sup>5</sup> described the morphological changes found in the liver of rats with partial obstruction of the common bile duct; Cole et al.3 found chronic cholecystitis in dogs with partial occlusion of the cystic duct; and we have reported elsewhere the chemical changes which occurred in the blood of dogs with partial obstruction of the common bile duct.9 The present paper describes the morphological findings in these dogs, and discusses their significance.

#### METHODS

Adult mongrel dogs weighing 18 to 52 lb. were used. Intravenous sodium thiopental anæsthesia was used for all operations. After the dog was suitably prepared, a right paramedian laparotomy was performed. The common bile duct was identified, and its distal part freed by blunt dissection down to its entry into the duodenum. A steel probe 2 mm. in diameter was laid alongside the common bile duct, and a suture of medium cotton tied round the duct and the probe, as near as possible to the choledocho-duodenal junction. The probe was then removed gently. In some of the dogs, a cholecystectomy was also performed. The abdomen was closed without a drain.

In 22 of the dogs in which a satisfactory degree of partial obstruction of the bile duct was achieved, satisfactory histological preparations were available. Six of the dogs died of operative complications or distemper within seven weeks of operation and therefore were excluded from the series. The other 16, six of which had undergone cholecystectomy, were sacrificed at intervals from 12 to 32 weeks after operation.

## GROSS FINDINGS

The part of the external biliary tree proximal to the constricting suture became markedly dilated. The dilatation was evident in dogs dying as early as three weeks after ligation, and was much more marked in dogs surviving for a longer time. In some dogs, the ducts became four or five times normal size. In the 12 dogs which survived more than three weeks and still had their gall bladder *in situ*, this organ shared in the dilatation. The bile retained its usual appearance, but in 15 dogs, 10 of which had undergone cholecystectomy, biliary concrements were found.

Because of the variation in weight of the animals, liver weights were considered

<sup>°</sup>From the Departments of Pathology and Experimental Surgery, McGill University, and the Departments of Surgery, Royal Victoria Hospital and St. Mary's Memorial Hospital, Montreal. Supported by a Grant-in-Aid from the National Research Council of Canada (MBT 755).

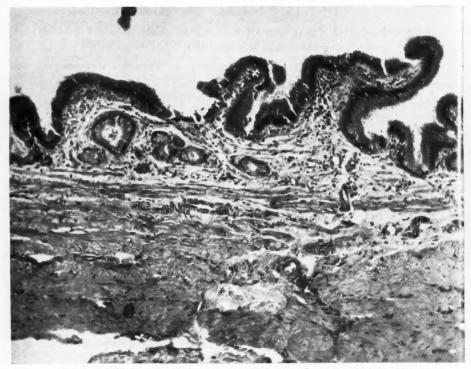


Fig. 1.—Gall bladder mucosa showing minimal chronic inflammation (H & E x 100).

to be of no significance. Grossly, the livers appeared somewhat enlarged as evidenced by rounding of the liver edge and increased capsular tension. Except in the two dogs with cirrhosis, the surface of the livers remained smooth and the organs showed no macroscopic abnormality on section.

## HISTOPATHOLOGICAL OBSERVATIONS

Although the dogs were killed from 12 to 32 weeks after the imposition of the constricting suture, the histological changes seen in the common ducts and gall bladders were similar in all specimens examined. The gall bladders had a mucus-secreting, folded mucosa which showed a mild chronic inflammation, with a small number of lymphocytes scattered through the mucosal folds and occasionally some cedema of the folds (Fig. 1). The mucosa of the common ducts was also made up of mucus-secreting cells. Although usually flat, it was occasionally folded, as was the mucosa of the gallbladder, and also showed a mild

chronic inflammation with lymphocytes scattered through the mucosal folds. The degree of inflammation above and below the constricted suture was identical. The constricting suture itself was seen in specimens from 13 dogs. It lay in the fat outside the wall of the common duct except in one dog in which it had ulcerated into the lumen of the duct. There was a moderate foreign body giant cell reaction around the suture, but little or no fibrosis (Fig. 2).

The principal microscopical abnormalities detected in the livers are summarized in Table I. It is evident that apart from the nodules in the sinusoids, and perhaps the proliferation of bile ducts, no change is present with any regularity. Indeed, many dogs showed no histological abnormality at all, except for the nodules in the sinusoids. These nodules were small conglomerates of cells which distended but did not disrupt a sinusoid (Fig. 3). The cells had irregular, hyperchromatic nuclei and eosinophilic cytoplasm. Occasionally, the

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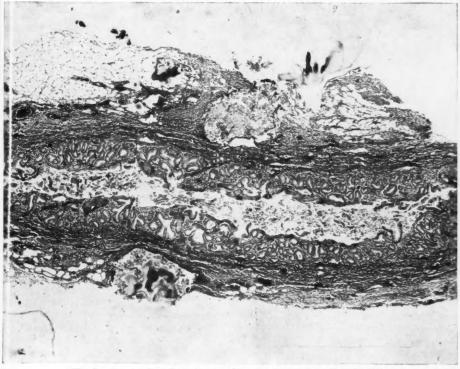


Fig. 2.-Common bile duct, showing the constricting suture (H & E x 35).

contained pigment. In a few instances, the aggregates were looser, and the cells appeared to be of the Kupffer variety. In no instance was hepatocellular damage associated with the nodules. The nodules were scattered irregularly throughout the

liver, and were uncommon, no section containing more than a few. They were found in 12 of the 16 dogs surviving ligation for more than 12 weeks.

Seven of the 16 dogs which survived the ligation for 12 weeks or more showed a

TABLE I.—SUMMARY OF MICROSCOPICAL FINDINGS

$egin{aligned} Dog \\ number \end{aligned}$	Survival (weeks)	Cholecyst- ectomy	Bile duct proliferation	Cirrhosis	Concentric fibrosis	Bile plugging	Centrilobular necrosis	Nodules in sinusoids
7	12	Yes	+	+	+	_	_	_
8	13	No				_	_	Name of the local division of the local divi
9	14	Yes	+	_			-	-
10	14	No	+	_	_		_	+
11	14	No	_	_	_	-		+
12	14	Yes	+		+	+		+
13	15	No	+	_	-	_	- minus	+
14	18	No		-	_	_	_	+
15	23	No	+	_		_		+
16	24	No	_	-		-	-	+
17	25	No						+-
18	30	Yes	-		-	_	_	+
19	30	Yes			-			+
20	31	Yes	_	-		-	_	+
21	32	No			-	-	-	
22	32	No	+	+	+	+		+

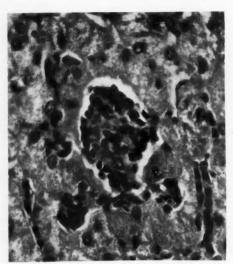


Fig. 3.—Nodules of cells distending a sinusoid  $(H \& E \times 400)$ .

marked proliferation of the intrahepatic bile ducts. In each case, only part of the liver showed the proliferation. In five of the seven dogs, the newly formed ducts supported by a minimum of stroma extended from the portal tracts as if to join adjacent tracts, though in most cases they reached only one-third or one-half of the way. In the other two there was true cirrhosis, with fine fibrous bands containing the proliferating ducts joining adjacent tracts (Fig. 4). Another abnormality was detected in three dogs where some of the portal tracts were enlarged three to four times by what seemed to be coarse collagenous tissue arranged in a more or less concentric manner (Fig. 5). In the affected tracts, the bile ducts were slightly dilated, with columnar epithelium, and the portal veins were widely dilated. Once again, only part of each liver was affected.

There was no evidence of an important cholangitis in any dog. In all animals, many of the portal tracts contained moderate numbers of round cells, but only in dog No. 21 were these numerous. Polymorphonuclear leukocytes were rare except in dogs Nos. 21 and 22, and even in these animals were not so numerous as to suggest a significant infection.

In dog No. 22, there were, in addition

to the cirrhosis, small foci of hepatocellula. necrosis without inflammatory reaction. this animal be excepted, the only hepatecellular necrosis found was the rather extensive centrilobular necrosis seen in foudogs which died of distemper early in the experiment and therefore were exclude from this series. Evidence of bile stasis wa also uncommon. Bile plugs were found i only two animals, and even in these wer few, and were found only in the centrilobular region. These two dogs also showed pigment, presumably bile, in some of the liver cells and Kupffer cells of the centri lobular region. Similar pigment was seen in the liver cells and Kupffer cells of the centrilobular region in dog No. 8.

The removal of the gall bladder did not seem to modify the severity of the histological changes found in the liver, or their frequency. Six of the 16~(38%) dogs underwent cholecystectomy. Of these, the gall bladder was removed in three of seven (43%) which showed proliferation of the intrahepatic bile ducts, one of the two (50%) with cirrhosis, and four of the 12~(33%) with nodules in the sinusoids.

#### DISCUSSION

In commenting on the histological changes produced in the liver and external biliary tract in these dogs with experimentally induced partial obstruction of the common bile duct, it is first necessary to emphasize that different species react to biliary obstruction in different ways. For example, as is shown in the review of Cameron and Oakley,2 extensive liver necrosis is striking in rats, guinea pigs and rabbits, though uncommon in dogs as it is in man. Considerable caution must therefore be exercised in comparing the findings in dogs with partial biliary obstruction with those of other species. Care must also be taken to distinguish between complete and incomplete obstruction.

In general, changes seen in the livers of the dogs with partial obstruction of the bills duct were similar to those reported in dogs with complete obstruction.<sup>2</sup> There was proliferation of the bile ducts, sometimes fibrosis of the liver, but little evidence of biliary stasis. Considerable variation in the

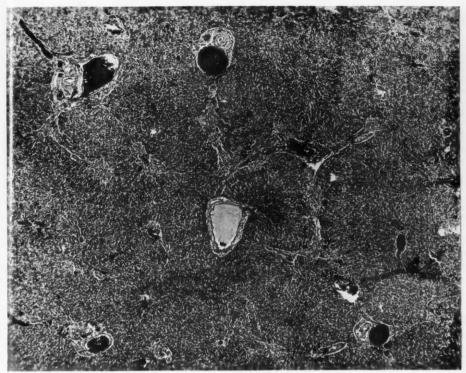


Fig. 4.-Liver showing early cirrhosis (H & E x 35).

severity of changes in different dogs is noteworthy. Several dogs retained livers which were almost normal histologically, while others developed quite severe hepatic damage. Reasons for this variation are not clear. It might be that the degree of obstruction varied in different dogs, or that in some the liver was more easily damaged by partial biliary obstruction. In this experiment there was no question of variation in the site of obstruction (which was an important factor in another series<sup>6</sup>) and cholangitis did not seem an important factor. It should also be noted that in any one dog the severity of hepatic damage varied from one part of the liver to another. If the findings in dogs are compared with those in human patients with extrahepatic biliary obstruction, several similarities appear.8, 10, 12, 13, 15 In both there may be proliferation of bile ducts, or even cirrhosis; in both, bile plugging may be slight or absent; in neither is there extensive necrosis of the liver such as follows extrahepatic

obstruction of the bile duct in several species; and in both, the degree of these various changes varies from one part of the liver to another, and from case to case. But there are also some important differences. In particular, the small foci of hepatocellular necrosis common in human patients with biliary obstruction were rarely found in the dog.

It should be noted that the expression "biliary stasis" does not describe accurately the condition existing in dogs with partial biliary obstruction. "Stasis" implies stagnation or stoppage. In most of the dogs with partial biliary obstruction the flow of bile may have been slowed, but it was not stopped or stagnant. The way in which partial obstruction produced hepatic damage in the dogs is not clear. Among possible mechanisms are an increase in the pressure of bile in the canaliculi and bile ducts, with damage to the liver cells and perhaps to the smallest bile ducts; an increase in the concentration of bile salts due to slow-

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Fig. 5.—Concentric fibrosis of a portal tract (H & E  $\times$  50).

ing or sludging of the bile, with irritation of the liver cells; or perhaps a lowering of oxygen tension due to a secondary reduction of blood flow in the sinusoids or to some effect on the extrahepatic afferent vessels at the site of obstruction.1 Such a mechanism would, of course, have to explain also the biochemical changes noted in dogs, and described in a previous paper,9 an early elevation in the serum alkaline phosphatase concentration with a subsequent return to normal, an early elevation in the serum bilirubin concentration with a subsequent return to normal, an early elevation in the serum globulin level and a later fall in the serum albumin level, and a late fall in the serum cholesterol concentration. Return to normal of the serum alkaline phosphatase and serum bilirubin concentrations suggests that some homœostatic mechanism exists which is able to limit or modify the hepatic damage caused by partial biliary obstruction; the later fall of the serum albumin and serum cholesterol concentrations shows that this mechanism is insufficient to give complete protection.

#### SUMMARY

A satisfactory partial obstruction of the

common bile duct was induced expermentally in 16 dogs. In six animals, ch lecystectomy was performed at the san e time. The dogs were killed from 12 to 2 weeks after obstruction. The absence of the gall bladder did not modify the frequency or severity of the morphological chang noted. The extrahepatic biliary tract grad ally became dilated to four or five times is normal size. Its mucosa showed a mil, chronic inflammation. Concretions we. found in the bile of 10 dogs. The live s showed little change macroscopically, e cept in two dogs which had cirrhos ... Seven dogs showed a proliferation of the bile ducts, though only in part of the live. In two of these, true cirrhosis was present. Three dogs showed a concentric fibrosis of some biliary tracts. Bile stasis was noted in only two dogs, and was never of more than minor degree. Hepatocellular necrosis was seen in only one dog, a dog with cirrhosis showing small foci of necrosis without inflammatory reaction. Twelve of the 16 dogs showed occasional clumps of cells, perhaps Kupffer cells, which filled and dilated a sinusoid.

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#### RÉSUMÉ

Cet article décrit les trouvailles et les constatations anormales faites sur le tractus biliaire et le parenchyme hépatique de chiens d'expérience ayant subi une obstruction partielle des voies biliaires.

Vingt-deux chiens bâtards furent employés; six d'entre eux moururent rapidement et furent éliminés de cette série. Les 16 survivants furent sacrifiés après des périodes post-opératoires de 12 à 32 semaines.

Macroscopiquement, on trouva une dilatation de l'arbre biliaire, atteignant un diamètre parfois quatre à cinq fois supérieur au diamètre normal. Souvent des concrétions biliaires s'étaient formées. La présence ou l'absence (chez les animaux cholecystectomisés) de la vésicule biliaire ne changeait rien à ce tableau. Le foie lui-même était généralement hypertrophié; sa surface restait cependant lisse et il ne montrait rien de notable à la section.

Histologiquement, les résultats de la stricture biliaire furent constants. Les muqueuses des voies biliaires et de la vésicule étaient en inflammation chronique légère; au niveau de la stricture une réaction à corps étranger avec nombreuses cellules géantes était visible. Dans le parenchyme hépatique, des nodules apparurent dans les sinusoïdes et un certain degré de prolifération des canaux biliaires se fit. Trois des animaux en expérience présentaient une fibrose concentrique péricanaliculaire; des signes de nécrose des cellules nobles ne furent détectés que chez un seul chien. Dans deux cas on trouva une légère stase biliaire.

## ARTERIOVENOUS FISTULA OF THE KIDNEY

Scheifley and his colleagues (Circulation, 19: 622, 1959) report three cases of renal arteriovenous fistula. Outstanding clinical features were hypertension and myocardial insufficiency which contrast markedly with those of the usual peripheral arteriovenous fistula. In every case in which these features were recorded, dramatic relief of heart failure and of lowered reserve followed corrective operation. Relief of hypertension also followed the operation.

Clinically, a loud, diffuse, continuous bruit was invariably present. Preoperative and post-operative catheterization and indicator-dilution studies, angiography and aortography are the diagnostic measures emphasized in these three cases. Arterialization of blood in the vena cava, greatly increased cardiac output, and markedly shortened recirculation times of the dye were found. Excretory urograms were abnormal. The mechanism producing hypertension appears related to the loss of pressure, decrease in flow,

and loss of pulsatile character in the renal artery distal to the fistula, eventually resulting in a type of Goldblatt kidney. A vicious cycle of increasing hypertension followed by increasing flow through the shunt makes heart failure inevitable. The authors advise auscultation over the renal regions in patients with cardiac enlargement or failure of unknown causation, with unexplained deformities in urograms or with renal tumours.

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#### FORTHCOMING MEETINGS

### THE SOUTH WESTERN ONTARIO SURGICAL ASSOCIATION

The Annual Meeting of the South Western (ntario Surgical Association will be held on November 16, 1960 at Victoria Hospital, London, Ontario. Clinical sessions will begin at 9 a.m.

For further information write to Dr. R. M. McFarlane, Secretary, Surgery Office, Victoria Hospital, London, Ontario.

#### AMERICAN COLLEGE OF SURGEONS

The 46th Annual Clinical Congress of the American College of Surgeons will be held in San Francisco, California, from October 10 to 14, 1960.

Doctors from all parts of the United States as well as from many other countries will attend sessions at this largest meeting of surgeons. More than 1000 will take part in the various programs as authors of research reports, teachers of postgraduate courses, participants in panel discussions, lecturers, and operating surgeons in motion pictures and closed-circuit telecasts.

Major addresses will be made by Dr. I. S. Ravdin, Philadelphia, Chairman, Board of Regents and incoming President of the College; Dr. Joseph Trueta, Oxford, England, who will speak on trauma and the living cell. Dr. Wendell M. Stabley, Director of the virus laboratory at the University of California, and Nobel winner in chemistry, will deliver the Martin Memorial Lecture, named for the College founder, Franklin H. Martin, on the subject of virus-cancer relationships. Mr. Leslie Philip Le Quesne, London, England, will give the annual Baxter Lecture, speaking on body fluid disturbances resulting from stomach obstruction. On the final evening, October 14, initiates will be presented for fellowship, honorary fellowships will be conferred and officers inaugurated.

The retiring President of the College is Dr. Owen H. Wangensteen, Minneapolis. Headquarters for the meeting will be the Civic Auditorium, with some sessions scheduled at nearby hotels.

Dr. Leon Goldman, Professor and Chairman, Department of Surgery, University of California School of Medicine, Berkeley, San Francisco, is Chairman of the local committee on arrangements.

#### HUMBOLDT UNIVERSITY, BERLIN

The celebration of the 250th anniversary of

the Charité of the Faculty of Medicine will be held in Berlin from November 6 to November 19, 1960, in connection with the 150th anniversary of the Humboldt University.

Applications for participation are to be directed to the Committee for the Preparation of the 250th anniversary of the Charité, Berlin N 4, Schumannstrasse 20-21, c/o Professor Dagobert Müller, secretary of the committee.

#### EIGHTH CONGRESS OF THE PAN-PACIFIC SURGICAL ASSOCIATION

The Eighth Congress of the Pan-Pacific Surgical Association will be held in Honolulu, Hawaii, from September 27 to October 5, 1960. All members of the profession are eligible to register and are urged to make arrangements as soon as possible if they wish to be assured of adequate facilities. An outstanding scientific program by leading surgeons promises to be of interest to all doctors. Ten surgical specialty sections are held simultaneously. Further information and brochures may be obtained by writing to Dr. F. J. Pinkerton, Director General of the Pan-Pacific Surgical Association, Suite 230, Alexander Young Building, Honolulu 13, Hawaii.

#### FESTIVAL INTERNATIONAL PERMANENT DU FILM MEDICO-CHIRURGICAL ET SCIENTIFIQUE

L'ouverture de la huitième session du Festival International Permanent du Film Médico-Chirurgical et Scientifique organisé, en collaboration avec la Gazette Médicale de France par l'Association Nationale des Médecins Cinéastes et des Cinéastes Scientifiques de France, aura lieu à la Faculté de Médecine de Paris, en novembre prochain.

Les réalisateurs de films médico-chirurgicaux ou scientifiques de format 16mm. substandard exclusivement, inédits en France, désirant participer à cette importante manifestation internationale, devront adresser leurs œuvres avant le 5 septembre prochain, date de réunion du Conseil Technique chargé de la sélection des films inscrits.

Tous les envois doivent être effectués à l'adresse de l'Association Nationale des Médecins Cinéastes et des Cinéastes Scientifiques de France 23, boul. de Latour-Maubourg Paris 7e. Les participants étrangers ont intérêt à faire acheminer leur envoi par le canal de l'Attaché culturel de leur Ambassade à Paris, via leur Ministère des Affaires Etrangères.

#### BOOK REVIEWS

(See also pages 323, 343, 346 and 356.)

ATLAS DE TECHNIQUES CHIRURGICALES: Les grandes techniques: cou, thorax, abdomen, chirurgie pelvienne, R. Michel-Bechet. 580 pp. Illust, G. Doin et Cie, Paris, 1958. 25,000 fr.

Cet Atlas est très largement illustré et les exposés sont succints. Il groupe de nombreuses techniques dont plusieurs sont personnelles à l'auteur. Son but est de faire un bref rappel des différents temps opératoires.

Ce livre, qui est d'une grande valeur, ressemble beaucoup à l'Atlas de techniques chirurgicales de Cutler et Zollinger qui a comiu un grand succès aux Etats-Unis. Les techniques de la chirurgie abdominale y sont très bien exposées et objectives. Cet Atlas a peut-être l'inconvénient d'être un peu lourd et volumineux.

MAY AND WORTH'S MANUAL OF DISEASES OF THE EYE. T. Keith Kyle, Consultant Surgeon and Director of the Orthoptic Department, High Holborn Branch, Moorfields Eye Hospital, Dean of the Institute of Ophthalmology and Civilian Consultant in Ophthalmology to the Royal Air Force, and A. G. Cross, Consultant Surgeon, City Road Branch, Moorfields Eye Hospital, and Civilian Consultant in Ophthalmology to the Royal Navy. 12th ed. 748 pp. Illust. Baillière, Tindall and Cox, London, 1959; The Macmillan Company of Canada Limited, Toronto. \$7.65.

This is the English edition of one of the best selling medical books of the last half century. It is a concise, practical and systematic ophthalmic text, suitable for medical students and general practitioners.

The relationship of neurology to ophthalmology is emphasized. The text has been brought up to date and includes the most recent developments in therapy. There is an excellent chapter on tropical eye diseases and a very interesting and practical chapter on ocular neurosis. As always, the colour illustrations are excellent.

This book is recommended to all students and practitioners.

NOUVELLE PRATIQUE CHIRURGICALE IL-LUSTREE Fascicule XIII (New Surgical Practice. Illustrated, Fascicle XIII). Edited by Jean Quénu. 276 pp. Illust. G. Doin et Cie, Paris, 1959, 3,350 fr.

Cet ouvrage est connu depuis de nombreuses années par les chirurgiens de langue française comme manuel de technique chirurgicale publié à l'intention des étudiants en chirurgie et des chirurgiens; il est donc un classique de la littérature médicale française. La présentation actuelle ne diffère guère de l'ouvrage qui, auparavant, était publié sous la direction de

Victor Pauchet. Il s'agit, en somme, d'un atles dans lequel chaque page est un dessin an tomique représentant un temps opératoire accompagné de quelques notes descriptives. Les dessins sont semi-schématiques, très bien faits et très faciles à comprendre. De temps à autre un chapitre débute par les indicatios opératoires, les principes de la technique et la description des soins pré et post opératoires.

Dans le fascicule XII, nous avons retenu a technique de la lobectomie moyenne qui est expliquée avec beaucoup de détails. L'aute r recommande le drainage supérieur à trave s une contre-incision scapulo-vertébrale, situee au niveau de l'épine de l'omoplate. Ce poi it de technique n'est pas habituel dans n's milieux. Le chapitre sur l'hypertension porta e est très bien fait et il y a des notes explicatives importantes sur la mesure de la pression portale, de même que sur la spléno-portagraphie peropératoire. L'anastomose porto-cave est décrite dans les détails de même que l'opération toute entière. Une autre technique intéressante décrite dans ce fascicule est celle de la pollicisation de l'annulaire. Cette méthode d'aborder le problème est ingénieuse et relativement nouvelle.

Dans le fascicule XIII, le chapitre sur la ligature des varices intra et extra-œsophagiennes est très bien fait. Ceci, plus la splénectomie avec anastomose spléno-rénale, que nous voyons un peu plus loin dans ce même fascicule, complète le traitement porto-systémique. On y trouve aussi une technique de lobectomie supérieure droite, pour cancer. Il s'agit, en somme, d'une lobectomie élargie.

Dans le fascicule XIV, l'auteur décrit sa technique de réparation d'une hernie hypogastrique. La technique décrite est une technique éprouvée. L'auteur recommande, cepenidant, l'emploi du crin de Florence, qui, dans nos milieux, a été complètement abandonné depuis assez longtemps. Par ailleurs, on recommande, avec raison, de drainer ces grands décollements, par un drain perforé attaché à une succion continue. Cette méthode est, sans aucun doute, préférable à l'emploi du drain cigarette ou d'une mèche, comme on le pratique habituellement. De plus, ce volume contient la description de plusieurs techniques de corrections orthopédiques qui nous paraissent excellentes.

En un mot, il s'agit là de manuels de techniques opératoires qui peuvent être très utiles, non seulement à l'étudiant en chirurgie, ma s aussi aux chirurgiens qui désirent revoir rapidement une technique opératoire. Le seul remoche à faire porte sur la division de l'ouvrage. Les chapitres ne sont pas groupés par région s anatomiques ou par maladies, mais semble t avoir été laissés au hasard. Cette disposition rend la consultation de ces manuels assez difficile; même si la table des matières semble bien faite, il n'est pas toujours aisé de retrouver la technique désirée.

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#### THE SURGICAL TREATMENT OF SCOLIOSIS. Louis A. Goldstein, Associate Clinical Professor of Orthopædic Surgery, University of Rochester

Medical Center. Appendix: Anesthesia in Sco-liosis, D. Vernon Thomas, Anesthetist-in-Chief, Strong Memorial Hospital of the University of Rochester Medical Center. 96 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press,

Toronto, 1959. \$7.50.

This excellent little monograph deals with the uthor's personal experience in the surgical t eatment of scoliosis. The method used, the Risser turnbuckle plaster, has been used t aroughout this series. The book presents briefly ne background on scoliosis and the indications for surgical treatment. The materials required in the method of application of the Risser icket are well dealt with. Mention is made of the criterion concerning correction prior to tusion, and the actual surgical procedure is described as used by the author. The author presents a critical analysis of his results and hese would show that this method in his hands has produced excellent results. He quotes a pseudarthrosis rate of approximately 10% in his series. No deaths were reported in this series, and the degrees of correction obtained in his curves (most of which were over 70%) and held after fusion, show that Dr. Goldstein's results are second to none. There is a brief chapter on anæsthesia in scoliosis by Dr. Vernon Thomas.

A TEXTBOOK OF SURGICAL PHYSIOLOGY.

R. Ainslie Jamieson, Surgeon, Vale of Leven Hospital, Alexandria, Dumbartonshire, and Andrew W. Kay, Professor of Surgery, University of Sheffield. 623 pp. Illust. E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Company of Canada Limited, Toronto,

1959, \$9.35.

This is a welcome and much needed book in which the authors present a concise but very thorough coverage of the subject of surgical physiology. Each chapter is complete and up to date, and presents in a readable form material which previously required the reading of many articles. In reading this volume one is impressed by the fact that the authors have emphasized the practical aspects of sur-gical physiology, and the physiology is always correlated with clinical applications. It is a complete text of surgical physiology yet avoids detail that is not of interest to the practising surgeon.

Although each system is well covered, the chapters on biological effects of radiation, fluid balance, adrenal and thyroid are particularly excellent and provide a complete and practical summary of current knowledge in fields where there have been many recent advances. The authors discuss clinical surgery on the basis of physiological findings in a fashion that is most useful to the practising surgeon; the chapter on fluid balance is particularly valu-

able in this regard.

Although the authors state that this volume has been prepared especially with the needs of the postgraduate student in mind, it is a book that is most useful for everyone engaged in the practice of surgery. It is a text in surgical physiology written by surgeons for surgeons.

THE TREATMENT OF BRONCHIAL NEO-PLASMS. Robert R. Shaw and Donald L. Paul-John Lester Kee, Jr. 135 pp. Illust, Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1959. \$8.75.

This is the third in the John Alexander Monograph Series, and is directed to all those con-cerned with the treatment of bronchogenic

carcinoma.

The monograph might better be subtitled a plea for the conservative surgical approach in the treatment of bronchogenic carcinoma. This, in effect, is the message of the authors. This message is particularly significant, today, in view of the rather dismal overall surgical results, even though it would appear, unfortunately, to be a minority opinion. As recently as April and May 1959, certain American and British authorities were making a plea for a more aggressive surgical attitude, that is to say, the so-called "extended" operation for carcinoma of the lung.

The authors stress the importance of biological predeterminism as opposed to the classical temporal theory in the consideration of specific therapy in a given case. Thus, the cell type, location and resistance of the host will determine the behaviour and prognosis, and the factor of time which is a consequence of these biologic traits, is of lesser importance.

By consideration of these facts, the authors contend, and logically so, that the thoracic surgeon will know which lesions are suitable for surgical resection and which are better treated by other means; which will be benefitted by radical resection and which may be treated by more conservative resection without sacrifice of survival time but with the attendant advantages of a lower mortality rate and a better quality of survival.

Included are informative chapters on irradiation, chemotherapy and terminal care in the hope that not only the quantity but also the quality of survival may be improved. The monograph also contains a less controversial chapter on bronchial adenoma, including details of certain bronchoplastic procedures.

The book is not without defects, viz., colour illustrations of relatively poor quality, and a good deal of repetition, which latter may possibly be excused since the message bears repeating. Altogether, it is a well organized and enlightened approach to a difficult problem and is quite readable.

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LES ENTRETIENS DE BICHAT. Chirurgie et Spécialités, 1959. (Colloquium of Bichat, Surgery and Specialties, 1959). Edited by Chigot, Bellin and others. 503 pp. Expansion Scientifique Française, 1959.

Ce volume est un recueuil de nombreux articles par des auteurs différents, couvrant plusieurs sujets de chirurgie générale et des spécialités chirurgicales. Bien qu'il soit impossible de donner une opinion d'ensemble sur un tel ouvrage, chacun des auteurs a tenté d'apporter une solution à un problème qui le concerne.

On peut reprocher aux éditeurs de n'avoir pas groupé ensemble les articles concernant un même sujet. Cette lacune est corrigée en partie par l'insertion à la fin de l'ouvrage, d'une table analytique.

En chirurgie du cancer, Huguier a étudié le problème du curage celluleux au niveau des parois latérales du petit bassin, en démontrant que la connaissance de l'anatomie de l'aponévrose pelvienne permet au chirurgien de trouver un plan de clivage en dehors de l'envahissement cancéreux, plan de clivage qui permet aussi une hémostase plus facile et plus efficace des veines. Un travail intéressant dans ce domaine de la cancérologie est celui de Bréhant, Leca et Lego. Ces auteurs ont tenté de dépister les métastases profondes et les adénopathies par l'exploration phlébographique portocave. Entre leurs mains, cette méthode a donné des précisions sur la technique opératoire ou radiothérapique à employer dans les cas de cancers abdomino-pelviens, testiculaires et des membres inférieurs. Dargent a pratiqué une transplantation de la surrénale gauche avec son pédicule artériel dans la rate, et une surrénalectomie droite.

Dans les cancers métastatiques du sein, il rapporte des résultats semblables à ceux qu'il a obtenus après surrénalectomie bilatérale. Dans les cancers de l'angle gauche du côlon, Toupet préconise une colectomie sub-totale avec iléo-sigmoïdostomie.

Plusieurs autres articles concernent la chirurgie général et les spécialités chirurgicales. telles que neuro-chirurgie, ophtalmologie, etc. Je ne retiendrai que l'article de Auvert sur les malformations congénitales de la veine porte. L'auteur fait un bon résumé du problème, préconise l'anastomose spléno-rénale comme traitement, et l'anastomose de la mésentérique supérieure à la vein-cave chez le patient qui a déjà subi une splénectomie.

En conclusion, le volume est une collection de travaux d'un groupe de chirurgiens français et est une aide à celui qui veut obtenir les dernières données de ces auteurs sur les problèmes qui y sont traités.

ATLAS DER GYNAKOLOGISCHEN OPERA-TIONEN (Atlas of Gynæcological Operations). Prof. Dr. O. Käser and Dr. F. A. Ilké, Kantonsspital St. Gallen, Schweiz. 451 pp. Illust. Georg Thieme Verlag, Stuttgart, W. Germany; Intercontinental Medical Book Corporation, New York, 1960, \$32.25.

This book of 450 pages with 720 illustrations is not only another good Atlas for gynæcological surgery but it also contains a very comprehensive source of information for the gynæcologist seeking advice in any operative situation.

The topography of gynæcological anatomy is closely connected with the bladder, ureters and colon. Some gynæcological procedures, especially the operations for carcinoma of the cervix may result in lesions of the urinary organs as a complication. For this reason particular emphasis is placed on the discussion of urological surgery.

The first chapter covers minor diagnostic and therapeutic procedures and operations on the abdominal wall. The second chapter discusses the different abdominal operations on the uterus and adnexæ, operations for the relief of pain, and operative procedures on the colon.

The third part includes vaginal operations on prolapsed genitalia, and vaginal operative approach on the uterus, adnexæ, vagina and vulva. Radical and ultra-radical carcinoma operations follow. The closing chapter contains ample information on the urological and proctological operations including the urinary system, and the treatment of stress incontinence.

The introduction outlines preoperative and postoperative treatment of gynæcological procedures and action during the cardiac arrest.

Some of the articles deserve special comment. The discussion and comparison of the Gilliam-Doleris-Simpson operation with the Baldy-Webster-McCall method is excellent. Aldrige-Richardson's total hysterectomy, the technique of Cæsarean section, Manchester's operation for prolapsed uterus and radical operations of Wertheim and Schauta are described precisely and are vividly and amply illustrated.

Subdivisions of every chapter are furnished with complete bibliography. It is the reviewer's opinion that this work of two famous Swiss gynæcologists will be a useful addition to the libraries of physicians reading German.

THE BIOCHEMICAL RESPONSE TO INJURY.
A Symposium organized by the Council for International Organizations of Medical Sciences

International Organizations of Medical Sciences Established under the joint auspices of UNESCC and WHO. Edited by H. B. Stoner with the assistance of C. J. Threlfall, The Toxicology Research Unit, Medical Research Council Laboratories, Carshalton, Surrey, England. 460 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto. \$15.00.

This book contains the proceedings of an international symposium on the metabolic effects

(Continued on page 371)

#### (Continued from page 368)

of injury, held in Austria in September 1958. The symposium was chaired by Dr. D. P. Cuthbertson, well known for his work in this feld over many years. It is an invaluable record of the papers presented and the discussion which followed them.

Many aspects of the biochemical response re covered. They include effects on the metalolism of carbohydrates, fats, proteins, water and electrolytes. Both local and general resoonses are dealt with and most forms of injury are discussed, including of course that esulting from surgery. The value of this book to students of the metabolic effects of injury i: unquestionable and such students will be from many disciplines-biochemistry, physiolgy, bacteriology, endocrinology, and medicine and surgery generally. However it is a book for those who are especially interested in the subject under discussion and are specially qualified to comprehend it. I cannot agree with the statement on the dust cover that the book will be of immediate interest to physicians and surgeons. As far as physicians and surgeons are concerned, it will be of immediate interest only to those with an excellent background of biochemistry and physiology and a specific concern with the details of the metabolic response to injury.

CLINICAL OBSTETRICS AND GYNECOLOGY, Volume 2, No. 4. Cesarean Section. Edited by Edwin J. DeCosta, M.D., ADVANCES IN GYNECOLOGIC SURGERY. Edited by S. B. Gusberg, M.D. Pages 927-1228, Illust. Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York, 1959. \$18.00 yearly.

The excellent standard set by preceding issues of this quarterly publication is again maintained in this number. A symposium on Cæsarean section contributed entirely by American authors comprises the obstetrical section and a discussion on indications and techniques is supplemented by chapters on anæsthesia, maternal mortality and morbidity following Cæsarean section, delivery following Cæsarean section and post-mortem Cæsarean section. Notably lacking in the discourse on anæsthesia is any reference to the use of epidural or to the combined techniques utilizing thiopental induction, light inhalation anæsthesia and relaxant drugs.

A symposium on advances in gynæcologic surgery contributed by 10 American authors gives their views on operations for infertility, habitual abortion, congenital malformations, vaginal plastic operations, vaginal hysterectomy and pelvic exenteration. Conservative surgery in the treatment of endometriosis is also discussed and the issue concludes with a special article devoted to the gynæcologic examination.

TREATMENT OF CANCER IN CLINICAL PRACTICE. Edited by Peter B. Kunkler, Radiotherapist, United Birmingham Hospitals, England, and Anthony J. H. Rains, Professor of Surgery, University of London. 821 pp. Illust. E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Company of Canada Limited, Toronto, 1959. \$17.00.

This 800 page book is a significant contribution to the long list of books on cancer; it is a delightful combination of surgery and radiotherapy in the management of the patient with cancer. It has been compiled by a surgeon and a radiotherapist with the assistance of numerous contributors on specialized subjects. While it purports to give proper weight to each, the surgeon will find this a useful text on radiotherapy and the radiotherapist a text on surgery.

An introductory chapter presents the history of the development of modern cancer treatment. Then follows a discussion on the general medical management of the cancer patient. The fundamentals of the surgical approach to cancer therapy are given concisely in one chapter and radiotherapists are urged to read this. On the other hand, surgeons will profit by reading some elementary radiation physics and the basis of the radiotherapeutic approach. Chemotherapy and hormone management are also presented in one of these introductory chapters.

Then follow 32 chapters covering each of the anatomical sites of malignant disease. Each is written by a surgeon and a radiotherapist and on the whole a better balance is struck in this book than in most where frequently controversy rather than co-operation is emphasized.

Although this book is British and presents the views of a wide range of authors there, the subject matter is universal. This text can be warmly recommended to postgraduate students in any branch of cancer work.

ARTERIAL EMBOLISM IN THE LIMBS. The Clinical Problem and its Anatomical Basis. A. L. Jacobs, Physician to the Whittington Hospital, London, England. 200 pp. Illust. E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Company of Canada Limited, Toronto, 1959. \$6.00.

The author has made an intensive study of 102 incidents of limb embolism in 69 patients, and he bases his opinions upon his clinical experience together with the results of radiographic injection studies at autopsy. The subject matter is well presented and the reader will find a most helpful bibliography. The author's opinions and conclusions have an authoritative ring, and are extraordinarily well set forth in a final chapter in which he expresses his views in summary form on the important aspects of embolism and its effects.

# DISEASES OF THE NOSE, THROAT AND EAR. A Handbook for Students and Practitioners. I. Simson Hall, Lecturer in Diseases of Nose, Throat and Ear, University of Edinburgh. 467 pp. Illust, 7th ed. E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Company of Canada, 1959, \$3.60.

Written for the general practitioner and the student, this volume well merits the popularity it has enjoyed for over 20 years. It is up to date, concise, and covers the specialty thoroughly in so far as concerns the student and practitioner. The sections on clinical examination and on office procedures are particularly useful. There are a few controversial points, such as the relative merits of the fenestration and the stapes mobilization operation for otosclerosis, which might perhaps receive a bit more attention. These in no way detract from the usefulness of this very readable and informative text. This seventh edition remains a most practical handbook of basic otolaryngology.

#### CHIRURGIE DU RACHIS. A. Sicard, Professor at the Faculty of Medicine, Paris. 484 pp. Illust. Masson et Cie, Paris, France. Paper bound F6000, linen bound F7000.

This monograph on surgery of the spine actually covers more than the title implies. It puts the accent on surgical techniques, as one would expect but it also extends far beyond the pathology of the vertebræ. It includes trauma, associated neurological manifestations, architectural anomalies, congenital malformations, infections, tumours, parasitoses, dystrophies and even the social aspect of spinal disabilities.

One hundred pages are dedicated to the description of operations performed on the spine at all levels, including vertebral biopsy and its delicate technique. Spinal injuries form the next longest chapter: its coverage is complete. Pain of spinal origin is a survey of all etiologies while sciatic pain is discussed under all possible angles. Curvatures, malformations, spondylolistheses are considered both prophylactically and therapeutically with a special accent on the opportunity and indications to operate. The chapter on tumours of the spine is perhaps not exhaustive but it places the surgeon in a realistic perspective, emphasizing the importance of timely and accurate decisions.

Vertebral echinococcosis is dealt with in the shortest possible chapter, perhaps the most original. Dystrophies are exemplified by brief comments and good radiological studies.

The monograph is well written and beautifully bound. The text is copiously illustrated by excellent drawings and radiographs.

Masson & Cie are the usual high-class editors. Professor Sicard has added a much needed document to the field of neurorthopædic surgery.

# AUTOCENOUS VEIN GRAFTS and related aspects of peripheral arterial disease. W. Andre v. Dale, Assistant Professor of Clinical Surger v. Vanderbilt University School of Medicine. Preface by Earle B. Mahoney, University f. Rochester School of Medicine and Dentistr 123 pp. Illust. Charles C. Thomas, Springfiel, Ill.; The Ryerson Press, Toronto, 1959. \$6.5.

The author deals fully with the question of the relative merits of veins, arteries and plastics as materials for vascular grafts in human. Backed by considerable experience both clinically and in the laboratory, and providing a good review of the pertinent literature with a fair presentation of the views of those with whom he disagrees, the author presents the case for the autogenous vein in preference to the other form of grafts.

This well illustrated book will be useful to all those with a special interest in vascular surgery and it may be regarded as a valuable summary of the present position in this rapidly advancing field.

# SURGICAL ASPECTS OF MEDICINE. H. D. Johnson, Examiner in Surgery for L.D.S., Royal College of Surgeons of England. 382 pp. Butterworth & Company (Canada) Limited, Toronto, 1959, \$13.00.

This intriguing title, carefully chosen from among a number of alternative suggestions noted by the author, quite accurately represents the intent that led to the publication of this volume and also describes faithfully the content of the text.

Recognizing correctly the fact that surgeons rely for their practice primarily on referrals from internists and general practitioners, the editor chooses to demonstrate the value of surgical treatment in common disorders and to enunciate the indications for surgical intervention in these disease processes. The book is thought necessary because all too frequently physicians do not have up to date information concerning the results of operative management according to present day standards. They may, therefore, consider surgery almost in the same light as their predecessors, when conservatism was often a necessary emphasis in view of the risk of operation which more than counterbalanced its potential value.

The presentation is concise, easily understood and successfully orientated towards the needs and primary interests of those who might wish to call in surgical consultants for advice in handling problems potentially amenable to operative repair. The book is a stimulating departure from the usual description of surgical material and bound to prove of value. One would think that it would undoubtedly be worthy of enthusiastic reception. Congratulations are in order to the editorial staff for farsighted approach to this important and all too often neglected facet of the treatment of disease.

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(Continued from page 372)

SURGERY OF REPAIR AS APPLIED TO HAND INJURIES. B. K. Rank, Hon. Plastic Surgeon, Royal Melbourne Hospital, and A. R. Wakefield, Plastic Surgeon, Royal Children's Hospital, Melbourne. Foreword by Sir Gordon Gordon-Taylor, K.B.E., C.B., LL.D., Sc.D., F.R.C.S., F.R.C.S. (Ed.), F.R.A.C.S., F.A.C.S., F.R.C.S. (Ed.), F.R.A.C.S., F.A.C.S., F.R.C.S. (Ed.), and Limited, Toronto, 1960. \$7.65.

The second edition of this work has not departed from the form of the first. There have been extensions of some of the material in the first and additional pictures. Otherwise, the text follows that of the first edition.

This is an extremely practical and useful book for anybody interested in doing surgery of the injured hand. The authors divide the injuries into what they call "tidy" and "untidy wounds, depending on their method of causation. The immediate treatment of such wounds is discussed including injuries to nerves, tendons and joints, and the types of skin closures that are available. Secondary repair is also discussed. There are separate sections on the treatment of the burned hand, on hand injuries in children and hand prostheses. This book can be highly recommended. It is beautifully published with clear type on good quality paper, and there are many excellent illustrations.

SURGICAL PHILOSOPHY IN MASS CASUALTY MANAGEMENT. With detailed notes on practical care. Warner F. Bowers, Colonel, United States Army Medical Corps; Chief, Dept. of Surgery, Tripler U.S. Army Hospital, Honolulu, Hawaii; and Carl W. Hughes, Lt. Colonel, United States Army Medical Corps; Chief General Surgery Service, Tripler U.S. Army Hospital, 204 pp. Charles C Thomas, Springfield, Ill.

Colonel Bowers (U.S.A.) and Lt. Col. Hughes (U.S.A.) have written a timely book whose value lies in a common sense evaluation of what can be done in the multitude of situations which may arise in relation to mass casualties produced by disasters, particularly those resulting from nuclear warfare. Although needing no justification, the authors excuse their works on the grounds that "it is our thought that most statements regarding mass casualties are still too theoretical and lacking in common sense; the requirements and demands are too high; the postulated situations are too unrealistic, and the presentations most often sponsor a feeling of defeat." Although there has been no experience with the proper handling of mass casualties such as envisioned with nuclear warfare, the authors draw on military experience and analysis of many large civilian disasters to expound their conclusions.

The outline of the extremes of philosophies

in such mass casualties is well done. At one end there is the belief that nothing can be done, and at the other the belief that a casualties must receive maximum care. The authors take a position in between, showing by analysis of the types of casualties and how they may be handled, that there is a place for careful planning, organization and repeatry-outs, especially for civilian disasters. De spite the weakness of "simulated casualt management", such planning and try-outs ar necessary even for civilian disasters since ican easily be shown, as is stated, that the average civilian disaster completely disorgan izes general hospitals anywhere on this continent. If these are well done, then a basis fo planning for nuclear warfare will have been laid. They carefully outline in considerable detail the types of casualties and their treat ment, the ideal care, and the many extreme compromises and adjustments that will be necessary in treating patients after such disasters. An outline of the fundamentals of all casualty management includes emphasis on "sorting" (triage). They underline the diffi-culty of having the civilian population and doctors unaccustomed to mass casualty work accepting the "no treatment" principle for hopeless cases. "The sheer magnitude of case loads" visualized under nuclear warfare obviates the "business-as-usual, take-it-in-stride, maximum-care attitude" held by both doctors and lay people. They foresee difficulties in changing this attitude. Then too, complete mobilization of all able bodied personnel is essential; doctors must not lose sight of the fact that "they will accomplish little or nothing unless literally hundreds of people in other fields do their jobs and do them well"; from the man who runs the bulldozer to the veterinary surgeon who can be allotted the task of wound treatment in human patients.

One chapter of the book is devoted to chemical and bacteriological warfare. The latter is described as being useful only for sabotage. Conversely they make the point that the use of "nerve gases" may make nuclear weapons obsolete, since these can destroy a population without affecting the facilities of a country coveted by the enemy.

In my opinion this is an excellent book of the subject with which it deals. It should be read by every doctor in Canada, and certainly by all those concerned with civil defence

#### Books Received

Books are acknowledged as received, but in some cases reviews will also be made in later issues.

Atlas of Anatomy and Surgical Approaches in Orthopædic Surgery – Upper Extremity. Vol. I Rodolfo Cosentino, M.D., Preface by Arthu Steindler. 192 pp. Illust. Charles C Thomas Springfield, Ill.; The Ryerson Press, Toronto, 1960. 311.50.

Cosmetic Surgery. Principles and Practice. Samuel Fomon, M.D., Director of Plastic Surgery, Sanhattan General Hospital, New York, N.Y., Conjulant in Plastic Surgery, St. Joseph's Hospital, New York; Honorary President, The American Dtorhinologic Society for Plastic Surgery, 651 pp. Illust. J. P. Lippincott Company, Philadelphia and Jontreal, 1960, \$27.50.

The Surgery of Theodoric. Circa A.D.1267. Translated from the Latin by Eldridge Campbell, 1.D., and James Colton, M.A. Vol. 2, Books III and IV. 233 pp. Illust. Appleton-Century-Crofts, nc., New York, 1960. \$5.50

Fundamental Techniques of Plastic Surgery and Their Surgical Applications. Ian A. McGregor, M.B., F.R.C.S. (Eng.), F.R.F.P.S. (Glas.), Consultant. Plastic Surgeon, Glasgow Royal Infirmary. Foreword by C. F. W. Illingworth, C.B.E., M.D., Regius Professor of Surgery, University of Glasgow. 244 pp. Illust. E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Company of Canada Limited, Toronto, 1960. \$5.00.

Interpersonal Relationships in the Hospital. Warner F. Bowers, Colonel U.S. Army Medical Corps and Chief of Department of Surgery and Chief General Surgery Service, Tripler U.S. Army Hospital, Honolulu, Hawaii. 125 pp. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1960. \$5.50.

Klinische Chirurgie fur die Praxis (In vier Banden). Band I, Lieferung 2. (Clinical Practice of Surgery. In 4 Volumes. Vol. I Part 2). Edited by O. Diebold, H. Junghanns and L. Zukschwerdt. 329 pp. Illust. Georg Thieme Verlag, Stuttgart, W. Germany; Intercontinental Medical Book Corporation, New York, 1960. \$6.40.

Klinik und Praxis der Urologie. (Clinical Aspects and Practice of Urology). Werner Staehler, University Hospital, Tübingen. 892 pp. Illust. Georg Thieme Verlag, Stuttgart, W. Germany; Intercontinental Medical Book Corporation, New York, 1959. \$57.15.

Osteochondritis Dissecans. Loose Bodies in Joints. Etiology, pathology, treatment. I. S. Smillie, Lecturer-in-Charge, Department of Orthopædic Surgery, University of St. Andrews. 224 pp. Illust. E. & S. Livingstone, Ltd., Edinburgh and London; The Macmillan Company of Canada Limited, Toronto, 1960. \$10.25.

Photography in Medicine. A Smialowski and D. J. Currie, St. Michael's Hospital, Toronto, 330 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1960. \$16.00.

Practical Proctology. Louis A. Buie, Sr., M.D., F.A.C.S., Emeritus Member, Section of Proctology, Mayo Clinic and Emeritus Professor of Proctology, Mayo Foundation. 737 pp. Illust. 3rd ed. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1937, \$24.75.

Principles of Orthopædic Surgery. Paul C. Colonna, M.D., Professor of Orthopædic Surgery, Emeritus University of Pennsylvania Medical School. 799 pp. Illust. Revised ed. Little Brown & Company, Boston; J. P. Lippincott Company, Montreal, 1960. \$22.00.

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